In this Issue
FLYING THE ATLANTIC

OCT.
1941

AVIATION

The Oldest American Aeronautical Magazine

McGraw-Hill Publishing Company, Inc.

Price 50c. per copy

Quarry Spotted

It was an American built plane, a Catalina Flying Patrol Boat that brought the Nazi battleship Bismarck to bay. The Bismarck had struck a devastating blow at British morale when it sank the British battle cruiser Hood and then scurried for the shelter of a French port.

The hue and cry was on. The English were grimly determined that the Bismarck should not escape. British destroyers combed the seas. British planes searched until depleted fuel supplies forced them back to aircraft carrier or bases.

It was a plane built in America—a sleek, far-ranging "PBY" Consolidated Catalina, powered with two 1500 H. P. American-built Pratt & Whitney Engines, that spotted the quarry and radioed back to bring up the pack.

Somewhere among the 8000 employees in the Thompson plants are men who shaped, machined and ground to five ten thousandths of an inch accuracy the 28 sodium filled valves that functioned to keep the patrol ship aloft through long hours of searching.

To these shop men it was their job—a job well done—a "valve job" of skill and craftsmanship. Legend has it that "for want of a horseshoe nail" a medieval battle was lost—a kingdom conquered. Perhaps a bit of heat dissipating sodium in a Thompson silcrome steel valve was a big factor in saving the honor of the British Navy May 27th, 1941.

THOMPSON PRODUCTS, INC.
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Manufacturers of over 1000 different aircraft engine and airplane parts, and original and replacement parts for the automotive industry. A pioneer of the sodium-cooled aircraft engine valve.

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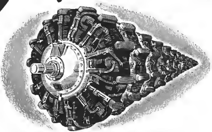

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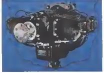

POWER BY LYCOMING

Illustrated is the Lycoming 100 h.p. engine. Other four-cylinder models are available in 50, 55, 65, 75 and 125 h.p. and six-cylinder models in 150 and 175 h.p. All are horizontally opposed with provisions for mechanical or electric starter and accessory drives.

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FREE LITERATURE We shall be glad to send you complete details and specifications of the new Lycoming 100, 125, 150 and 175 horsepower engines. Address Lycoming Division, Dept. A101, Aviation Manufacturing Corporation, Williamsport, Pa., U. S. A. Cable address: Aviatcor.

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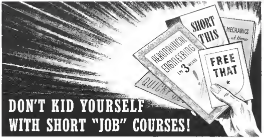

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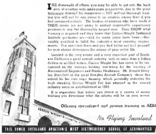

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PBY type
long range
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In addition to the loop-type cushion clamp shown above, Bendix Aviation Ltd. manufactures twelve other styles of tube clamps, some of them shown here. A complete new specification book is available to engineers requesting it on company letterhead.

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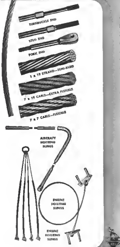

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Corrosion and other damage caused by moisture is no longer a problem in plants where PROTEK-SORB is on guard. Vital engine parts, accessories, complete engines and even complete planes are being protected by Protek-Sorb while in storage or shipment. Planes are being assembled FASTER because costly, time-wasting slushing compounds are no longer needed. New uses for Protek-Sorb are being found daily.

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If moisture is a factor to be reckoned with in the production or performance of your product, let our research and engineering department show you how Protek-Sorb will overcome the hazards that moisture presents.

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This cylinder barrel is in perfect condition after a two-month test using Protek-Sorb to keep it free of corrosion. The cylinder barrel shown was wiped absolutely clean, then shipped to and stored in the tropics, then returned to the United States under normal conditions. Protek Sorb did its job perfectly.

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is a product of
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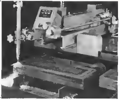
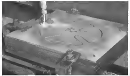
BALTIMORE, MARYLAND

Oxy-Acetylene Stack-Cutting Quickly Produces Identical Parts from Stock Steel

1. What it is

Oxy acetylene stack-cutting is an adaptation of the flame-shaping process. This method produces quantities of identically shaped parts of practically any size from clamped piles of steel plates or sheets. Steel ranging in thickness from 16 gauge to 1 inch is being cut with good results—in piles as thick as 5 inches. If the plates are correctly clamped, the cut edges are clean and smooth. Stack cutting can be done with either portable or stationary flame-cutting machines. In the illustration at the right, an Oxweld cutting blowpipe is shewing through 4 plates, each 1 inch thick.





2. How it saves

Oxy-acetylene stack-cutting produces needed parts from stock steel quickly, and usually at lower cost than parts already shaped can be obtained. Stack-cutting is in most cases a faster and cheaper method than shaping single parts by mechanical means, and it also helps conserve steel because it reduces scrap losses. Additional savings result when machining operations are done on the flame-cut stacks before the parts are separated. The uniformity of stack-cut parts facilitates fabrication and assembly.

3. Linde can help you use it

Linde can help you determine where and how you can profitably use Oxweld flame-cutting equipment for the shaping of parts by stack-cutting. In addition to supplying the oxygen, the acetylene, and other essential materials, Linde also makes available to its customers, motion picture showings, how to do-it literature, and on the job service which help operators do a consistently good stack-cutting job. If you want to know more about this process—or about any other oxy-acetylene process—*ask Linde!*

The Linde Air Products Company

Unit of Union Carbide and Carbon Corporation

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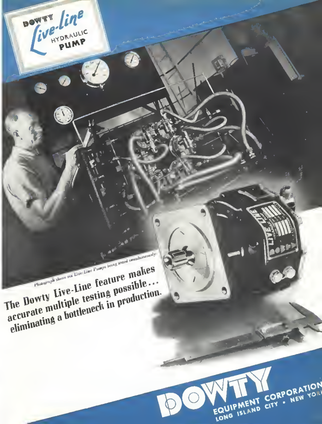

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Prices of South Bend Lathes are published in our price list No. 49-A dated Jan. 10, 1941. These prices are net to the purchaser f.o.b. South Bend, Ind. They are fair and reasonable, and you should pay no surcharge, premium or mark-up of any kind, other than actual transportation charges to your city.

When you deal with an authorized South Bend Lathe distributor these are the prices you are asked to pay—no more, no less. If any other dealer offers you a South Bend Lathe at a higher price for immediate delivery, it is not in accordance with any policy established by us. We will appreciate your reporting all such proposals to us for investigation.

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INTERCONTINENT Aircraft CORP.
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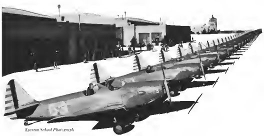

Spartan School Photograph

is getting it on the line!

At Spartan School in Tulsa, and in scores of other schools, the broad line of America's defense begins. More than two hundred husky Fairchild Trainers in Spartan schools alone start the instruction of Air Corps cadets, flight instructors, and civilian students.

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Division of Fairchild Engine & Airplane Corporation
Hagerstown, Maryland . . . Cable Address "Faircraft"

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*Based on three shifts working 40 hours a week per person

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Their equipment facilities and plant capacity are adapted to many operations required on defense contracts now in process, or just being started. Many manufacturers who have prime contracts or sub-contracts or Government agencies inviting bids will find that Packard and Associates fit into the picture splendidly.

Listed on this page are some of the pertinent facts about this centrally located group and the manufacturing operations they are equipped to handle.

[INQUIRIES INVITED]

For complete information write, wire or phone for descriptive brochure.

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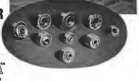
Homer E. Capehart, President
AND ASSOCIATES
KENTUCKY AT MORRIS STREET, INDIANAPOLIS, INDIANA

NORTHROP "N-3PB" PATROL BOMBER

IS *Equipped* WITH "NORMA-HOFFMANN" PRECISION BEARINGS



Designed, engineered and produced in seven months from date of order, by Northrop Aircraft, Inc. (Hawthorne, Calif.), the "N-3PB" is one of the world's fastest military seaplanes. NORMA-HOFFMANN PRECISION BEARINGS are a part of its control system—imparting extreme sensitiveness and time-tested dependability.

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Write for the Catalog. Let our engineers work with you

NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN., U. S. A., FOUNDED 1911

UP UNCLE SAM'S SLEEVE...

In the Northrop Sector of the Battle of Production, dive bombers roll off the assembly lines.

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Not just to help put America ahead, but to keep her ahead, through research and development—is a Northrop tradition.

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WATCH Northrop

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Fire Power IN THE AIR

● Pictured here, in actual size, are projectiles of the 37 mm. cannon and the .50 and .30 caliber machine guns carried by the speedy Bell Airacobra. The Airacobra is the only single engine interceptor pursuit airplane in production today which fires one pound and a quarter 37 mm. explosive shells. This formidable fighter plane is one of the U. S. Army's answers to the question of FIRE POWER IN THE AIR.

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GET ALL THE FACTS

This comprehensive brochure has been prepared to simplify the task of determining where Lyon facilities can be used to best advantage in accelerating the National Defense Program. A copy is yours for the asking.

LYON METAL PRODUCTS, INC.

BALL BEARING DO'S AND DON'TS FOR MECHANICS

Mounting the Bearing

Gus like to had kittens the day he caught Curly – that's our bald-headed mechanic – getting careless with a center punch when he was staking a ball bearing housing. Curly is banging away, hitting the bearing shield as often as he hits the housing. "Might's well th'ow the bearing away," Gus grumbles . . .

GUS SAYS "DON'T!"

DON'T toss new bearings, returned unused from mechanics, back into a stock bin without wrapping them. Or putting them in a paper envelope.

DON'T leave unwrapped bearings lying on the bench while you get ready to use them.

DON'T try to clean or grease new ball bearings – the maker's already done that job for you.

Third of a series of instruction sheets published by The Fafnir Bearing Company, based on its experience with the leaders of U S aviation

PRESS-FITTING the bearing, put pressure *only* on the outer ring in a housing mounting, *only* on the inner ring in a bolt or shaft mounting.

IN HOUSING mountings, be sure bearing is started square in housing If it gets "cocked", it may not seat, or may mis align.

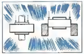
FIT SNUG, but not so heavy as to exert radial pressure on the inner or outer ring which might cramp the bearing Where shouldered housings or shafts are used, be sure to press bearing all the way home

AVOID STRIKING the shield A dent in it may interfere with ball travel.

CHECK MOUNTED bearing to be sure it runs free If it is mounted in an accessory part, tape it to keep it clean until part is ready for final assembly If this is final assembly, be sure that misalignment doesn't cramp bearing

NEVER BEND or otherwise distort parts carrying ball bearings A little distortion can "freeze" the bearing entirely.

Write your bearing problems to The Fafnir Bearing Company, Aircraft Div., New Britain, Conn.



THE *Lockheed* LOG

LEADERSHIP *in Reliability*

MODERN WAR has provided a great proving ground for American aircraft. The tough and demanding conditions of war flying have produced real testimony to the reliability and stamina of Lockheed airplanes. Scores of Hudson bombers have made the transatlantic ferry trip to England under their own power. Hundreds have seen service over the coastal waters of Britain... the Bismark was first sighted off Norway from a Lockheed. Hundreds have taken the pounding of battle and brought their crews home safely. This kind of reliability is not forgotten.

Lockheed is proud of the performance of its airplanes in commerce and in war. Down to the last craftsman there is a personal interest and pride that stimulates careful and willing workmanship. It's a spirit that, even three years ago, enabled the record-breaking delivery of 250 Hudson bombers nearly two months ahead of schedule... resulting in additional large orders. It's a spirit that has earned the confidence of a great nation in *Lockheed reliability*.

More than any other Lockheed, this Hudson bomber is symbolic of Lockheed reliability. It is number 1000 of a production effort that has never wavered. It represents the spirit and willingness of 30,000 men and women to do their share in national defense. 999 other Hudsons have gone before it. Some have gained fame in battle... others still wait their chance... but all have the same inherent qualities of stamina and dependability.

On the occasion of this bomber's completion Lord Halifax, Great Britain's ambassador to the United States, spoke to the men of Lockheed. He said, *"I bring you the thanks of my people for the skill, craftsmanship, work and goodwill that you are putting into these fighting ships. I shall take back with me a story of encouragement and expanding production. The planes you send us are proof of your knowledge of your craft."*

LOOK TO *Lockheed* FOR LEADERSHIP

LOCKHEED AIRCRAFT CORPORATION • BURBANK, CALIFORNIA, U.S.A.

The Birdmen's Perch

We've heard of birds that flew backwards to keep the wind out of their eyes—but who ever heard of a 'plane that flew right up its own exhaust pipe? See this month's Whopper!

Major Al Williams, alias "Tattered Wing Tips,"
Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa

FUNNYBONER DEPT.

Dear Major

It happened the night before the 1938 Oakland Air Show. A banquet was being held for the contestants, officials, and us unimportant enthusiasts.

I had decided to fly a Taylorcraft across San Francisco Bay to Mills Field. The afternoon was dismal and squally, while fog stretched up the Bay, its base at about 100 feet. The tower said that Oakland was wet but that visibility was O.K. So, with fine disregard for the C.A.A. item concerning having both wing tips in one fog bank, I decided to make a quick dash through.

But with my mind more on the anticipation of hob-nobbing with aviation men of great renown than on the 'craft, I never gave the compass a glance. The seat of my gabardines told me I wasn't slipping while my ears reassured me as to level flight.

I flew on and on, and still no Oakland. Then I glanced at my watch. Twenty minutes had elapsed! Just as I started a little arithmetic, the fog broke, and there before my unbelieving eyes was—Mills Field!

I *know* I had made a 180° turn, but someday I'm going to sit down and figure out how many 360°'s I had made. I do know that watching my compass I should have made the flight in 5 minutes.

Sincerely
Martin H. Bolsan
Glendale, Calif

THIS MONTH'S BRAIN TWISTER

The following puzzle is sent in by J. L. Centanni of New Orleans

Three planes were at New Orleans Airport for refueling with G.A.G. Only a certain amount of gasoline was available. Plane No. 1 took on ¼ of the gas available; plane No. 2 took 20 gallons; and plane No. 3 took twice as much as planes Nos. 1 and 2 combined. How many gallons were taken?

FUSSY AS AN OLD MAID

"Fussy fellows" come in for a lot of kid-

ding. You know the type—they're always tinkering, never satisfied that the engine couldn't be tuned a little better, or that a different cockpit arrangement wouldn't be more efficient. Strangely enough, most flyers are like this—they're fussy fellows about planes.

At Gulf, we're fussy, too. We were so fussy about Gulfpride Oil that we weren't satisfied with ordinary methods of refining. We wanted to get more impurities out. So we developed a special process to do it—the Alchlor Process.

As a result, *more* of the harmful carbon- and sludge-formers are removed from Gulfpride—a high percentage more than in the case of most oils. That's why Gulfpride is such a safe, efficient lubricant. We know that when it comes to taking care of an airplane engine, you fellows appreciate extra fussiness.

THIS MONTH'S WHOPPER

Dear Major,

I had a car, but no more. If your G.A.G. wasn't so good, I wouldn't have flown my car, and if I hadn't flown my car, I'd still have it. Here's why!

I had a new car that would do 114. It seemed so light and smooth that I figured if I flattened out the fenders it would fly.

Well, it wouldn't quite take off, just bumped along the ground. Then I figured that if I was going to fly it, I ought to use aviation gasoline. So I trotted down to the hangar and borrowed 5 gallons of G.A.G. That was all it needed!

The car took off with the grace of a DC-3 and the speed of a P-40. The next day I was driving in town and some idiot wrinkled up my left fender. When I got out on the open road, I forgot about the fender and took off. Immediately I remembered it, 'cause the doggone car started to fly in ever-decreasing concentric circles, until it flew right up its own exhaust pipe and left me sitting on the gas tank 200 feet up. But with the G.A.G. in the tank I was safe as a church. I glided down

to a three-point landing, shouldered the tank, and walked fourteen weary miles back to the field. And that's how I lost my car.

Your footsore pal
Max R. Corey,
Kelly Field, Texas

AVIATION

Established 1916

OLDEST AMERICAN AERONAUTICAL MAGAZINE

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FLASHES

picked up along the editorial airways

War on Two Fronts

» FROM THE CONFLICTING CLAIMS of Germans and Russians it is extremely dangerous to draw conclusions about the progress of the war. But as the days lengthen into weeks and the weeks into months, it becomes increasingly apparent that there is an antidote for the blitzkrieg variety of poison. Very little has been known about Russian military strength, but events of the past three months are beginning to indicate the accuracy of our predictions that Soviet air power was a close second to that of Germany (See Box Score, AVIATION, January, 1939). With the great German war machine spread out over a long thin line and apparently digging in for a cold, hard winter, it is obvious that somebody, intoxicated with overconfidence, has sold Germany a two-front war. Regardless of the outcome, this provides the democracies with the most precious ingredient of victory,—time. We cannot help wondering whether or not the best possible use is being made of this priceless time.

» WE ARE TOLD that the R.A.F. bombing of Germany and her occupied territories is being done according to a definite plan in which the Bureau of Economic Warfare furnishes the R.A.F. with information on the whereabouts of strategic materiel, transportation centers, and critical manufacturing establishments. This, and the increasing accuracy of bombing, may account for the minuteness of the damage shown in aerial photographs of the R.A.F. objectives taken after bombing raids have been completed. And we have reason to believe that the British have been very careful to concentrate their destruction on military objectives and give warning to civilians of their intentions to conduct bombing raids at specific points in occupied areas.

» WITH THE NAZI-DESIGNED FRENCH AIRCRAFT PRODUCTION PROGRAM just getting underway, it is interesting to note that engineering changes and improvements are verboten and the the French factories have been assigned to purely production work on the familiar German designs that have been used in the present war. These ships include Messerschmitt 110, Heinkle 111, and JU-52. Selection of the latter indicates the intention of still more extensive parachute troop carrying in the near future. Whether or not this French program, which also includes long-range ships, will amount to anything remains to be seen. With the passive, and sometimes active, resistance of the French, the increasing bombing accuracy of the R.A.F., and the Nazi preoccupation with Russia, the French effort, which took so long to get organized, may roll out into one great goose egg.

» OUR OWN DELIVERIES SPURTED to 1854 planes in August, or about three times as many as we turned out in August, 1940. This figure checks exactly with our predictions made nine months before (See "The Truth About the Defense Program" by T. P. Wright, AVIATION, January, 1941). These estimates call for about 2350 per month by the end of this year and 2500 per month by next spring. We are rapidly approaching the level

Close coordination between design and production is indicated in this photograph of a section of the experimental department at Bell Aircraft. Here engineers are afforded first hand contact with the product they are designing.

of German production as of the beginning of the war, and we are reaching the point where each month's score should contain a higher percentage of combat craft.

» ANYONE WHO BELIEVES the slanderous talk that has been circulated about the quality of our airplanes will be interested in a new book written by an R.A.F. officer and a member of the British Air Ministry In "War in the Air" by David Garnett, we learn that the author saw planes labeled "French Order" being uncrated as recently as late last spring This means that obsolete craft are still being placed in service by the British. There is much mystery, even in some of the higher places, about where our later airplanes are, but one thing is certain They are not finding their way to the front very rapidly Mr Garnett pays high tribute to the Lockheed Hudsons of the R A F Coastal Command and to the Douglas DB-7s, whose range and power fits them admirably for night fighter functions. He believes that the war will be won when the R.A F has a fleet of 2,000–3,000 long range bombers of the Flying Fortress type and productive capacity to provide replacements

» MR. FLOYD ODLUM has been selected by the President for the delicate task of spreading the defense job among small manufacturers One of the discoveries Mr Odlum will make is that you can't make subcontractors overnight The only successful subcontractors are those who have been trained with great patience by the primary contractors Close and continuous contact between the two is absolutely essential It can best be accomplished locally and any organization to handle it must be highly de-centralized But with time and patience it can be done, and we recommend that all concerned read "Putting the Small Shop to Work" by Harvey L. Williams in AVIATION for July, 1941, to appreciate the problems and see how it has been done in New England

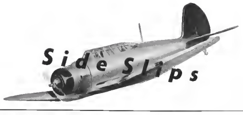
» THE AIRLINE EQUIPMENT PICTURE has brightened slightly since the Joint Aircraft Board (Army Navy, British) has approved the Air Transport Association's request for 175 planes to go into service during 1942 and 1943 Although this replacement program doesn't start until June, there is provision for the A T A to present emergency needs to the Board before that time. Although this program is not by any means ideal, it is at least a program and it should enable the airlines to make their plans ahead, subject of course to the degree of emergency. And it is absolutely sound from the standpoint of national defense to make provision for a certain degree of airline expansion. August traffic broke all records at 146,500,000 revenue passenger-miles, or one-third more than that of the same month last year Cumulative total for the first eight months of 1941 is 869,967,867 passenger-miles.

» A CRITICAL SHORTAGE OF MAINTENANCE MECHANICS has developed and will steadily become worse if immediate action is not taken One of our editors has just returned from a swing around the country He reports that the men with A and E certificates are in great demand There are not enough civilian mechanics at Air Corps depots, Naval air stations, airline bases, privately operated repair shops or in the service departments of manufacturers While an unskilled man can be rapidly trained to do a simple production job in a factory, at least a year is required to qualify a mechanic for an Airplane and Engine certificate. In their great rush to get factory jobs, most youngsters have taken short courses in private or public schools rather than the one or two year mechanics courses.

With the shortage of trained men now existing, and with the need for still more mechanics to maintain the new airplanes that are being built, it is a national waste to permit the facilities of the well-established private schools to remain idle We understand that the C.A A may train mechanics as it has pilots, using approved mechanics schools We are strongly behind this move but urge that special care be given in qualifying men for these scholarships

SAVE TIME BY AIR

"Maguire hasn't yet learned the traffic rules in his own aircraft plant.



Side Slips

» The easiest way to write about aviation is to ask one expert what the dope is, on a given matter. He tells you positively just how things are, and you go back to your office and write it, and it's very interesting. Only it's liable to be wrong.

A more conscientious writer, like this department, for instance, will try to keep from getting it wrong by asking a *lot* of experts, or at least several. But that doesn't work out very well either, because no two of them tell you the same thing. Thus, under the multiple-interview system, your contradictory facts cancel themselves out so that you have no story at all. Or, you can *write* your story, putting in all the conflicting viewpoints. But this is confusing, especially to the reader, who is liable to cancel his subscription if you keep on with it.

Discouraged over this state of affairs, we recently hit upon an entirely new method of getting information. We decided to put our questions to somebody who knows nothing at all about aviation. For this purpose we singled out a girl we know, named Muriel, took

her out to a dollar dinner, and went to work. "What do you think about aviation?" we asked her.

"I think it's terrible but not hopeless," she replied, lighting one of those new long cigarettes. "I think the human race will come within a gnat's eyebrow of killing itself off with airplanes, but not quite. Then, in maybe a thousand years, the airplanes will bring the different countries into contact with each other so that people will stop thinking of other people as 'foreigners,' and stop fighting."

Not bad, we thought. Most after-dinner speakers would have said it in 14 pages of ghost writing. Thus encouraged, we asked Muriel what she thought of the air cooled vs liquid-cooled engine situation.

"What is the difference between them?" she asked.

We told her all the differences the engineers have been talking about, in 20 minutes.

"You mean the air-cooled one sticks out in the wind and the other one doesn't?" she said.

"Well—yes," we admitted.

"I like the air-cooled one," said Muriel, replacing her lip rouge, which had come off on an ear of corn, "because there's air everywhere you go in an airplane. But if the other one makes the fighting planes go faster, they should use it, too. I think we should have *both* kinds."

So, if our readers like this report, we may switch over from "well informed sources," to reliably uninformed sources. Most of whom, like Muriel, don't mind being quoted.

» Not only are the British telling aviation men in Washington what to do, and hanging British accents on them at the same time, but they've got us tagging fancy names on our planes. First came the Lockheed "Hudson," then the Consolidated "Catalina", and the Martin "Baltimore." Now comes Douglas with the "Boston" bomber, and Brewster with its "Bermuda" dive bomber. Consolidated also has its "Liberator." Lockheed's two-engined interceptor is dubbed "Lightning", which begins to taste of toast and marmalade. But the Douglas DB-7A night fighter, "Havoc" is the last British word: it's the roast beef and Brussels sprouts. Now we are ready for the Revenge the Glorious, the Triumphant—boy, fetch my Thesaurus.

» As engines get bigger and bigger, the engineers try to figure out a propeller that will soak up all the power. To design propellers, one has to know a lot of special differentials and aerodynamics and material stresses. But almost anybody with a nice sense of things mechanical can *imagine* a good prop. A good prop for those new four and five-thousand horsepower engines would be maybe 40 or 50 feet in diameter, something like a Dutch windmill,

only chromium plated. It should run slow—none of that air-sawing noise you have now. Ought to feel like a corliss valve engine in a high priced yacht—tremendous power, with a gentle swish. You should be able to come home in a plane thus equipped without waking the watch dog. All you need with this propeller of ours is some way to get your wheels down on the ground. Hey, Cleghorn, call in a couple of those engineers and have them design some airplane stilts.

» Remember Alcock and Brown, who flew the Atlantic in 1919? Well, that was 22 years ago. Those two men are now Sir John Alcock and Sir Arthur Whitten Brown. Sir Arthur, 55 and grayhaired, is miffed because he is not allowed to fly bombers across the Atlantic. He is an officer in the RAF Volunteer Reserve Corps and is a squadron commander in the air training. His wife is a company commander in the Auxiliary Territorial Service, and his son is an RAF pilot.

Flying the Atlantic

Trans-Atlantic flights are now a daily occurrence. Pan American Airways pioneered scheduled operations on this route and developed the basic flight techniques now in general use. This, the first of three articles on PAA operations, describes the multiple flight crew and how it is trained.

On May 27, 1939, when the Yankee Clipper headed eastward on the inaugural flight of the Transatlantic Clipper service, Pan American technicians had a rather full and respectful knowledge of the physical difficulties they would encounter in their new operations

For more than five years, Pan American meteorologists had been making special studies of Atlantic weather, had participated in field trips to Iceland, Greenland and Labrador They had by 1939 been preparing daily transatlantic weather maps for more than two years In 1937 five final survey flights gathered further weather data and information on landing conditions along the routes under consideration

Using the most advanced long-range transport aircraft yet developed, it was still in 1939 impractical to negotiate the distances involved in an Atlantic crossing without one or more refueling stops The geographical mileages between island stations available for such purposes are generally as formidable as the 2 402 miles between San Francisco and Honolulu, the longest sector of the transpacific airway It is 2,020 miles from Bermuda to the Azores It is 2 397 miles from New York to the Azores. It is 3,118 miles from Bermuda to Lis-

Not so many months ago, the technique of transoceanic transport was still considered very much a specialty of interest only to a limited number of specialists. Today in America outside the basic problems of mass aircraft production no topic seems of wider aeronautical interest than this one of transoceanic flying. Every multi-engined airplane larger than an interceptor is potentially a transoceanic aircraft In more than a half dozen bustling schools military naval and civilian airmen are laboring through intensive courses of instruction in transoceanic navigation and meteorology Pilots, mechanics, engineers, technicians are being enlisted by the hundreds in what was so recently an art with but a handful of practitioners

Forming the core of all their study are the techniques and practices developed in a decade of operating across the Caribbean, the Pacific, and the Atlantic by the Pan American Airways System The national importance of that experience was recognized recently when Pan American was enlisted by President Roosevelt in the task of forwarding aircraft across the South Atlantic and Africa to the Middle East This general review of the application of the Pan American technique to the problems of the North Atlantic Clipper service is the first of several which AVIATION will offer its readers on this subject.

bon As we shall see, it is the last of these distances which was frequently to control transatlantic operations after 1939

Superimposed upon these substantial geographical requirements are many factors of weather and climate, more severe than any previously encountered in air transportation. Over any possible North Atlantic route strong westerly components feature the prevailing winds during all seasons of the year One westward crossing was actually to be made in 1940 in the teeth of headwinds which averaged 41.9 miles per hour While wind conditions are not always so difficult, the accomplishment of westward passages is always far more of a task than flights made eastward

Added to this pattern of prevailing westerly winds are storm areas of high frequency and varying intensity Weather in New England and the St Lawrence Valley is proverbially the most variable and storm-featured in North America. Characteristically, today's weather in these regions is tomorrow's weather over the western North Atlantic Affecting this phenomena (unfavorably) are movements of air masses southeastward from the Greenland ice cap, and northerly from the hot, moist, southern regions of the Atlantic

The transatlantic airway is higher in average latitude than the easternmost sector of the transpacific route Climatologically it is far more northerly in character than would be indicated by the latitude differences. As a result almost every winter cloud formation penetrated in the course of Atlantic flying is, in all probability, the locus of icing conditions Fog conditions, resulting from the mixing of the Labrador Current and the Gulf Stream are frequent During the months between Oct 1 and April 1 sea-swells in the harbor of Horta exceed 3 feet on 35 days out of each hundred, and exceed two-and-one-half feet on 57 days out of each hundred The climate of the eastern U S seaboard is such that harbor ice can be expected in winter months at every available landing harbor as far south as South Carolina

Such were the basic new air transport obstacles which Pan American faced when it began scheduled transatlantic operations in the spring of 1939 The outbreak of war in Europe in September of that year was to increase these difficulties many-fold.

Within all previous concepts of transoceanic flight technique, it was obviously desirable to recruit every possible source of meteorological information which might bear upon Atlantic weather. Before the start of its services, Pan American had spent a number of years in organizing just such a transatlantic weather service In conjunction with the U. S. Weather Bureau, it had arranged for complete daily reports from land stations covering the entire North American continent, and for corresponding reports from U S vessels plying the Atlantic and the collection of data from European vessels in the western half of that ocean Through working agreements with the air transport companies of Great Britain, France, and Germany, it had arranged to secure complete reports from those nations on the weather of the Eastern Atlantic and Western Europe The outbreak of war drove all European shipping from the seas, or silenced their radios It cut American-flag sailings down to the operations of a half-dozen vessels It made absolutely impossible any question of securing information from the belligerent governments

Pan American had likewise based its plans upon the expectation of extensive summer use of the northern transatlantic route via Newfoundland and Ireland,

(*Turn to page 184*)

All photos by Pan American Airways

The commodious flight deck of a Boeing Clipper Forward, in the left seat of the cockpit, is the Captain who commands the crew of ten. At his right sits the First Officer In the left foreground is the Navigator, who is Second Officer. In the extreme right foreground is the Flight Engineer, Behind him is the Radio Officer.

The Navigator takes a star sight into the transparent turret top of the wing

The Flight Engineer's post. The establishment of this job has done much to relieve the Captain of the details of watching the performance of the four engines

Messerschmitt Menace

Designed for increased performance at high altitudes, the new Me 109F is armed with a Mauser cannon capable of the formidable rate of fire of 900 rounds per minute.

IN its newly modified single-seat fighter, the Messerschmitt Me 109F, Germany has installed a potentially formidable weapon in the shape of a 20 mm. Mauser cannon which is reported to have the phenomenal rate of fire of 900 rounds per minute. This, together with the two 7.92 mm. Rheinmetal-Borsig machine guns, comprising its total armament (although provision is also made for a 550 lb bomb slung between the landing gear), gives the Me 109F a weight of fire approximating that of the latest cannon-equipped Hurricanes and Spitfires.

The Messerschmitt's armament is short-winded, however, only 200 rounds being supplied the 20 mm. cannon, sufficient for 13½ seconds continuous firing (a 15 mm. Mauser in the Me 109F2 probably carries more ammunition), and 500 rounds each for the two machine guns, which is considerably less than what the British fighters carry. The cannon is belt-fed from an ammunition box housed in the right wing, and is electrically cocked and fired. Apparently reliable, its amazing rate of fire equals that of the 50 Browning machine guns used by the R.A.F. in the Boeing Flying Fortresses. Aiming is by means of a reflector sight, described by British sources as rather inferior.

A sound, well-constructed airplane, the new Messerschmitt is powered by a 12 cylinder Mercedes Benz DB 601 N engine which develops 1,150 hp. at 2,600 r.p.m. at take-off, and at 16,500 ft. is rated at 1,050 hp. An increase in power of about six percent over the earlier DB. 601 A at all heights has been achieved by changing from concave to flat-topped pistons which raised the compression ratio from 6.9 to 7.9. This has resulted in increasing maximum speed at 13,300 ft. from 354 to 362 m.p.h., and at 21,000 ft. top speed is 380 m.p.h. The ceiling has gone up from 36,000 to 40,000 ft., although it is doubtful whether the pilot could operate at that altitude without a pressurized cockpit, about which reports make no mention. Tests carried out by Boeing Aircraft have indicated that it is as difficult to breathe at 40,000 ft. with an oxygen mask as it is at 18,000 without one because the rarified atmosphere cannot supply sufficient lung pressure. Moreover, without a pressurized cockpit, and so far none has been known to be incorporated in a fighter plane, the pilot flying at such extreme altitudes is subject to "aeroembolish", similar to the diver's "bends", especially in a fast combat plane which climbs and descends at great speeds.

Apart from minor alterations, few changes have been made in the fuselage construction. Such as have been made, however, have increased its length by three feet to 29 ft., 8 inches. A new rudder, larger spinner, through which the cannon protrudes, and the re-arranged oil tank are the principal changes contributing to greater length. A fixed cantilever tail plane has replaced the antiquated adjustable braced tail plane of the Me 109E, and instead of trimming tabs, small adjusting tabs, which can be set on the ground, are provided on the elevators. The landing gear retracts outwards into leather-walled, zipper-fastened wheel wells, while the tail wheel retracts only partly, leaving half the wheel projecting.

The new wing radiator arrangement provides an efficient cooling system. A Mauser cannon, firing through propeller hub and two machine guns mounted over engine, comprise new Messerschmitt's armament.

Photo British Combine

Forced down in almost undamaged condition, the Me 109F is revealed to be considerably improved over the old Me 109E. Rounded wing tips and larger spinner are the most obvious changes.

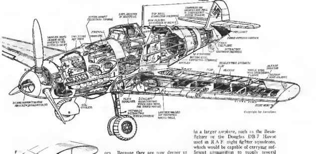


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Fig. 1. Me 109F wing radiator arrangement: "A" boundary layer air. "B" air to radiator "C". "D" air from radiator. "E" hollow flap discharging boundary layer air. "F" flap.

An interesting feature is the Sperry-type blind flying panel. A master compass, connected to a repeater dial on the instrument panel, is installed in the rear fuselage. To protect the pilot an 8 mm. armor plate curves forward and over his head from the rear cockpit bulkhead. Drag has been decreased somewhat by lowering the cockpit cover and streamlining it more.

The "L" shaped fuel tank, consisting of a rubber bag housed in a plywood casing, is situated behind and under the pilot and is protected by armor plate 10 mm. thick placed in front of it. Capacity of this tank is 105 gallons. An extra fuel tank may be slung under the fuselage in a bomb rack.

Wing span has been increased nine inches to a total of 33 ft., with an area of 186 sq.ft. as against 176.5 sq.ft. of the older model. The curved tips, two feet one inch long on each wing, which modify the former rectangular wing tips, are suspected by the British to be a sly Nazi stratagem to confuse the Me 109F with the Hurricane, rather than to serve a real technical purpose. Taper ratio remains about the same.

Perhaps the most interesting feature of the wings is the re-arrangement of the radiators and flaps, and a kind of boundary layer ducting over the radiators. Because they are now deeper in the wings, the radiators project only slightly below the under surface. As shown in Fig. 1, the boundary layer air is picked up in the duct just forward of the radiator, over which it is led, and discharged through the hollow upper flap. This top section moves up, normally, when the under section is lowered, thus controlling the air flow and preventing a change in lift. On landing, the top flap drops and the lower moves progressively ahead of it at a greater angle, and so maintains the cooling flow through the radiator. A small auxiliary flap at the lower leading edge of the radiator duct prevents stalling of the air at the lip when the rear flap is lowered.

The new cooling system, affords a far better duct than before, a large expansion on entry and low velocity cooling with sufficient control. A third radiator is installed under the engine.

Several details of the power plant have been altered, the oil tank has been removed from behind the engine and placed atop of the reduction gear where formerly the glycol header tank was installed, and the header tank has been halved and placed on either side of the crankcase. Changing of the engine has been facilitated by the change in position of the oil tank, for there are now no oil pipes to disconnect.

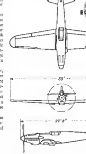
The supercharger air intake is bigger, and to get a better flow it has been set farther from the fuselage. A constant speed propeller governor prevents over-revving of the engine in combat maneuvers, and a cut-out is provided so that the propeller can be used either as a fixed pitch or manually controlled type for cruising speed.

Although the Mauser cannon is the new Messerschmitt's outstanding feature, its real efficiency would be obtained in a larger airplane, such as the Beaufighter or the Douglas DB-7 Havoc used in R.A.F. night fighter squadrons, which would be capable of carrying sufficient ammunition to supply several such guns.

The specifications of the Messerschmitt Me 109F, powered by a Mercedes Benz DB 601 N 12 cylinder engine, as reported from England, are as follows:

Span	33 ft.
Length	29 ft. 8 in.
Height (to mid point of spinner)	7 ft. 1 in.
Wing area	186 sq.ft.
Aspect ratio	5.85 dihedral
Wing loading	36.6 lb./sq.ft.
Weight empty	4,740 lb. (estimated)
Gross weight	6,000 lb. (estimated)
Maximum speed (at 21,000 ft.)	380 m.p.h.
Range (at 307 m.p.h.)	370 miles
(at 262 m.p.h.)	600 miles
Service ceiling	40,000 ft.

FOREIGN EQUIPMENT



The windowless office building is sound proofed and air conditioned. This is the production and planning division

War Bird Brooder

All the experience and "know how" of Douglas production engineers have been utilized in designing the great blackout plant at Long Beach.

By Charles F. McReynolds *Pacific Coast Editor, Aviation*

BUILT to breed blackbirds for night work, the new Long Beach plant of Douglas Aircraft Company is quite properly a "blackout" factory as a precaution against visits from unfriendly night birds. Newest and largest military aircraft plant to be placed in production since start of the expansion program, the Douglas Long Beach factory is also notable for its many unique features, and is impressive for its obvious efficiency as a military plane production center Howard Houghton, manager of the new plant, is reported to have remarked that if Adolph Hitler could only spend an hour inspecting the new Long Beach factory it would alter his ideas as to the ineffectiveness of the Democracies Certainly no one can visit this plant without being impressed with the capacity America has for adequate self defense

There have been many new aircraft plants built recently, particularly in the Southern California area, but the Douglas Long Beach factory is notable for the stark realism with which complete provision has been made for war time operation This plant is built to operate under fire—to maintain production even when enemy bombers are overhead, if such a contingency should ever arise, and there is every reason to assume that the entire establishment would be able to continue production with a minimum of interruption under even the most grim attack from the air.

Completely air conditioned and artificially lighted throughout both office and shop buildings, this factory is said to be the first completely windowless major plant to be erected on the Pacific Coast Light traps are provided so that not a single tell-tale beam will betray the plant's presence at night. A dead black exterior paint is effective both at night and in the daytime in killing light reflection from the buildings and causing them to merge with the flat land on which they are built This effect is enhanced by the flat top roofs of all buildings Even in the daytime it is difficult to locate these buildings from the air.

Protective coloration is by no means the only defense provided against air attack, however The factory is divided into eleven major units, each separated by wide areas so as to isolate it from the other buildings Thus not more than one building can be affected by any one bomb The exterior walls of all buildings are of a "sandwich" material consisting of corrugated iron sheeting with a heavy external coating of dead black bitumastic type paint while the inside is covered with a thick layer of insulating material While by no means bomb proof, this wall would certainly absorb most of the splinters and fragments from an exploding bomb, and the multilayer wall material would not rip or shatter under bomb impact

All buildings are protected against fire by an extensive system of automatic water sprinklers and all utilities are duplicated to prevent damage to water or electric lines from stopping production in any department To localize any possible bomb damage there have been further provisions such as installation of a "zone" type air conditioning system with a total of 70 separate and complete air conditioning and refrigerating units and 22 boiler rooms Oil and gasoline supplies are stored in special vaults, and bomb proof vaults are provided for important company documents, engineering records, etc The office and personnel buildings, located to the east of the manufacturing buildings, are windowless concrete structures of bomb-resistant design

Howard D. Houghton, Plant Manager

Production planning

Despite the extensive attention which has been given to air raid precautions the new Douglas plant has not sacrificed production efficiency at any point On the contrary there are numerous features which will serve to speed production in this plant over any previous effort. Original plans called for production of attack-bombers and military transports of Douglas design, but under the B V D plan provision has been made for production of a third type the Boeing four-engined 'Flying Fortress"

The Long Beach plant is but one of four factories to be operated by Douglas and has been coordinated with the other three factories as well as with Boeing and Vega in connection with the B V D bomber production scheme, and also with major sub-contracting firms such as Murray Body, Briggs Mfg Co Pullman-Standard Car Mfg Co, Fleetwings, and McDonnell Aircraft The above named subcontractors are already in production on Douglas work approximating $100 000 000 The Long Beach factory is the third major Douglas unit to go into production, the first being the parent plant at Santa Monica, and the second the factory adjacent to Los Angeles Airport and known as the El Segundo Division A fourth factory is

(Turn to page 182)

Railroad spurs run through one end of the receiving building as well as alongside a series of great sliding doors.

Below: the plant is made up of numerous units separated by wide paved areas. This picture was taken last March

Above: Taken last spring while construction was going on this photograph shows how corrugated sheet is fastened over insulation blocks.

D/F Loop Navigational Techniques

Continuing a basic discussion on the principles and use of direction finding equipment

By C. H. McIntosh *Instructor in Charge, Chicago Pilot Training School, American Airlines Inc*

Part II

IF there is any salient advantage in the use of the aircraft direction finder over the several other commonly used methods of navigation, it is the essential simplicity of direction finding technique. This, combined with the navigational flexibility and accuracy which the direction finder affords, should make some form of this equipment a "must" item on any airplane engaged in extended cross-country flight

For all practical purposes a radio bearing can be considered as merely an extension of a visual line of sight. Once this basic idea is clearly recognized, the application of direction finding techniques to aircraft is readily grasped

Almost everyone, for example, has observed a surveyor at work. An instrument termed a transit is used which consists primarily of a telescope and an azimuth scale. The instrument is always set up so that the 0 deg. of the scale indicates north. The telescope may be turned through 360 deg and the direction of any line of sight can be read in degrees from north on the azimuth

The relationship of the surveyor's transit to the radio direction finder should be readily apparent. Except that the direction finder's azimuth scale has its 0 deg point aligned with the airplane's nose instead of north, the scale in each instrument serves the same purpose. It has already been explained how bearings relative to the airplane's nose may be converted. The loop null position takes the place of the telescope and furnishes directional radio bearings instead of visual bearings

Since this close relationship exists between surveying and radio direction finding, it is not surprising to find that many of the same principles are applicable to each art. Likewise, since the marine navigator's pelorus is nothing more than a special adaptation of the transit for marine navigation, a large portion of aircraft direction finding technique has been taken from marine practice with the pelorus. This is particularly true with respect to obtaining a fix by means of bearings.

It should not be assumed, however, that the navigational applications of aircraft radio direction finding completely parallel those developed for visual bearings. Recent, advanced developments of the automatic, visual indicating radio compass come nearest to accomplishing this. Aural null direction finding equipment, however, as distinguished from the radio compass, creates certain types of navigational problems which are completely avoided with either visual or radio compass bearings (see Article I in the Sept issue of AVIATION, for the difference between radio compasses and direction finders)

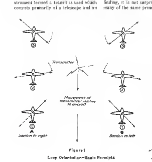


Figure 1
Loop Orientation—Basic Principle

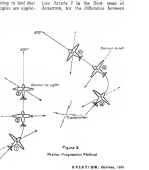


Figure 2
Pointer Progression Method

As commonly used, the aircraft aural null type radio direction finder affords the pilot or navigator with an easy means of resolving four basic types of navigational problem. These are

A. Orientation in relation to a radio station. This consists mainly of eliminating the 180 deg ambiguity of bearing common to direction finders. By definition a radio compass does not have such ambiguity and therefore eliminates the need for orientation problems

B. Homing. By definition homing is considered as flight toward a radio transmitter while using a null signal maintained on that station for directional guidance.

C. Running Fix. This consists of determining the *geographic* position of the airplane at any desired instant by taking successive bearings at strategic intervals on one radio station.

D. Instantaneous Fix. This is a determination of the airplane's geographic position by taking two or more bearings in rapid succession on different radio stations

Principles of Loop Orientation

Mention has been made in a previous article that radio direction finders as distinguished from a radio compass furnish only a *line of bearing* through the position of the airplane and the radio transmitter upon which a null is being obtained. In other words, when a null signal is obtained on a transmitter, the general direction of which is uncertain, a choice exists between two bearings exactly 180 deg apart. The double null pointer on the azimuth scale provides a constant reminder of this

This characteristic of the direction finder necessitates some orientation procedure to determine which of the two readings on the azimuth scale is the correct bearing on the station

Referring to Fig 1, it will be evident that the whole secret of loop orientation is in the relative motion of airplane and transmitter. Actually, any airplane in flight is always moving forward in relation to a stationary ground transmitter, or expressed differently, the movement of the airplane is always tending to place the transmitter behind the airplane. A little thought will make it evident that this is true regradless of the airplane's course or position with respect to the transmitter. In terms of relative motion it is perhaps easier to think of the airplane as stationary and the transmitter always moving backward

Viewed in this manner, then, if a null signal is maintained on a transmitter by rotating the loop while the airplane holds a steady heading, *the null pointer moving backward from the airplane's nose must point to the transmitter*

Fig 1 shows this clearly. Two assumed flight paths past a transmitter are indicated, A with the station to the right, and B with it to the left. A steady heading is being held. The double pointed arrows represent the typical double null pointer

In both cases the indication of the null pointer is shown for three positions of the airplane as it moves forward in relation to the station. At position 1, the direction of the station is unknown, and thus the null bearing is 180 deg ambiguous. At positions 2 and 3, the change in null pointer indication reflects the relative movement of airplane and station. In each case it will be seen that the null pointer which correctly indicates the station bearing, moves back from the airplane's nose toward the tail. Thus, the right pointer indicates the station to the right at A, and the left pointer indicates the station to the left at B

While it is perfectly possible to resolve the 180 deg ambiguity of the loop without a more formal procedure than ascertaining the motion of the null pointer, a more positive method is recommended. For example, although the correct relative motion exists, it is impossible to obtain null *pointer movement* if the station happens to be directly on the nose or tail. Likewise, the angular change in pointer indication will be very slow whenever the original null bearing on the station is near the nose or tail. Since the angular change in pointer indication is most rapid when the null is in line with the wing tips (90 deg to the longitudinal axis), it is most advantageous to start any loop orientation from this initial position

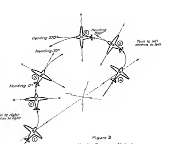


Figure 3
Heading Progression Method

Loop Orientation—Pointer Progression Method

Fig 2 illustrates a loop orientation procedure favored by airline pilots. It embodies in all respects the principals explained in the foregoing paragraphs

Assuming that the position of the airplane in relation to the station is unknown, either position 1 or 4 in the diagram is possible with the line of bearing illustrated. To orientate, the following simple procedure is sufficient

1 Rotate the loop in order to align the null position with the airplane's lateral axis. The null pointer will read 90-270

2. Execute a standard rate turn either right or left until a null signal is again picked up. This momentarily places the airplane exactly broadside to the station as in positions 2 and 5. Note the airplane's heading

3 Continue to fly this heading as close as possible* while at the same time rotating the loop as required to hold the null signal

4 Whichever null pointer moves away from the airplane's nose indicates the direction to the station. At position 3 it is evident that the right pointer indicates the station is to the right, at position 6 the left pointer indicates the station to the left

The advantages of this procedure are obvious. It is rapid and positive. It is ideally suited to transport work since a minimum of airplane maneuvering is required

The disadvantages are not quite so apparent. However, in a small airplane carrying only one pilot, it may be difficult to maintain a steady heading

(*Turn to page* 148)

* In all subsequent discussion of D/F techniques, use of a directional gyro is presumed.

Simplified Cruising Control

A Method for Constant B.M.E.P. Airline Operation

By Allan A. Barrie, *Western Air Lines* **and John B. Cutting,** *Pratt & Whitney Aircraft*

INTRODUCTION of the constant speed propeller has made it possible to operate aircraft engines at constant B.M.E.P., which results in substantial operating economies. Several airlines use the constant B.M.E.P. method of operation, varying the propeller pitch and carburetor throttle opening and mixture control to attain the desired result. But it has not been easy to provide the operating crews with data easily used in the cockpit of the plane which would make it possible for the desired constant B.M.E.P. to be maintained under all flight conditions.

When Western Air Lines brought its power plant equipment up to date with Pratt & Whitney Twin Wasp R-1830 S1C3-G engines, it was decided to bring the operating technique abreast of the equipment. In the past most air lines have followed an operating procedure somewhat along the lines described by E. T. Allen and Dr. W. Bailey Oswald, in a series of articles entitled "Operation at Desired Cruising Conditions", published in AVIATION magazine in February and April, 1934. At the time these articles were published the constant speed propeller had not come into the picture. The introduction of the constant speed propeller has separated the interdependence of manifold pressure and r.p.m., and allows an infinite combination of these quantities in achieving the desired constant B.M.E.P.

It must be understood that the ideal condition is to operate, not only at a constant B.M.E.P., but at the highest B.M.E.P. which the fuel normally used will permit. Of course we are not interested in B.M.E.P. as such. What we want to do is to translate engine power into airplane performance over the usable range of the equipment. A concrete illustration will assist us in visualizing this problem.

The flight from Los Angeles, Calif. to Las Vegas, Nev., a distance of 252 miles, is scheduled by Western Air Lines to consume 1 hour and 35 minutes, using Douglas DC-3 airplanes with the Pratt & Whitney Twin Wasp engines previously mentioned. We divide this flight into seven parts, as shown in Fig. 1, as follows:

X-A From blocks to take-off point
A-B Take off and climb to 500 ft.
B-C Cruising Climb
C-D Cruise
D-E Cruising descent to 500 ft.
E-F Approach and landing
F-Y Taxi to blocks

The first three phases of the flight, because of their fixed procedure, do not offer the pilot a means of controlling his time of arrival at destination. In fact variations here that are outside of the pilot's control must be deferred to the later portions of the flight which are amenable to control. A late passenger delays the departure from the blocks. Traffic conditions may hold the plane on the ground several minutes longer than is allocated to "no progress" time. Up to the time the airplane reaches cruising altitude nothing can be done to make up for these delays.

However, Western Air Lines' procedure has been arranged to minimize the effect of these delays. Nine minutes is allowed in the schedule for taxiing, take off and climb to 500 ft., with a half-turn bringing the plane even with the field and headed on the route. Terrain conditions dictate a minimum cruising altitude so the climb is standardized and it can be predicted that a 19-minute cruising climb will bring us to point "C" in Fig. 1, which is over Palmdale, Calif. Up to now the pilot has been following a procedure which is not varied. Hence, 28 minutes after leaving the blocks, the airplane is at 11,000 ft. and 46 miles (plus or minus the wind) on its way. This procedure simplifies the calculating required of the crew during the early stages of the flight. After this point cruising control can be exercised. We must make the next 206 miles in the remainder of the time allowed. This distance includes cruise, descent and approach, all involving variations in the speed of the airplane.

Here another practical short-cut, proven over long experience, is used. We consider the remainder of the trip including approach, and taxiing, to be the same as continuous cruise. In Fig. 1 the total time consumed in descent (D-E), approach (E-F), and taxiing (F-Y) is the same as though the cruise line (C-D) were continued to form the line (C-Y). In other words, the increased speed of descent is closely balanced by the time required to approach the field and taxi to the blocks. So, in our example, the pilot completes his calculation by dividing the remaining 206 miles by the time left, 1 hr. 7 min., giving a required true airspeed of 184 m.p.h. Referring to Fig. 8 we select the engine setting giving us 185 m.p.h. true airspeed at 11,000 ft. alt., or 1860 r.p.m. with full throttle, which will result in an indicated airspeed of 153 m.p.h. A glance at the table and the pilot's information is complete. This engine setting is maintained to the point where the descent is completed, or Point "F".

This cruising control table combines in one readily usable form information that usually is supplied in three separate graphs. The procedure of developing this table is as follows:

1. From the airplane manufacturer is obtained the chart shown in Fig. 2, which gives the engine brake horse power required against true airspeed and altitude.

2. From the engine manufacturer is obtained the chart shown in Fig. 3, which gives the r.p.m. and manifold pressure characteristics against power and altitude.

3. We combine these two charts in Fig. 4. In this instance cruising power is based on constant B.M.E.P., consequently, below full throttle each constant power line calls for a constant r.p.m. below the critical altitude for the selected B.M.E.P. This critical altitude shows in Fig. 4 as the full throttle line. Above this line operation is at full throttle and diminishing B.M.E.P.

4. From the airplane manufacturer we also obtain the airspeed indicator calibration shown in Fig. 5. Combining this with the fuel consumption curve of Fig. 6 and adding these to Fig. 4, we obtain the cartographer's dream shown in Fig. 7. It is believed that no essential information has been neglected.

The use of constant B.M.E.P. for cruise was decided upon after consultation with the engine manufacturer. It was recommended as the operating method giving the maximum of engine efficiency and dependability. However, the chart could be so constructed that the same complete information given would be based on constant r.p.m. operation. The essential efficiency of this graph is that it gives the cruising information specifically for the complete range of conditions.

To satisfy the requirements of cock-

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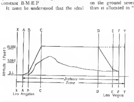

Fig. 1 The seven divisions of flight between Los Angeles and Las Vegas.

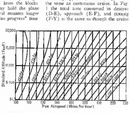

Fig. 2 Engine brake hp. required, plotted against true airspeed and altitude

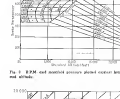

Fig. 3 R.P.M. and manifold pressure plotted against brake hp and altitude.

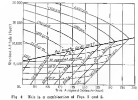

Fig. 4 This is a combination of Figs. 2 and 3.

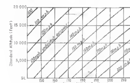

Fig. 5 Indicated airspeed calibrated with altitude and true airspeed.

Fig. 7 The fuel consumption curve of Fig. 6 is shown added to the chart of Fig. 4.

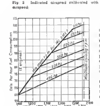

Fig. 6. Fuel consumption curve

Structural Features of Beads

How to use beads in aircraft construction and when not to use them.

By F. R. Shanley, *Chief Structures Engineer, Lockheed Aircraft Corp*

THE design of modern "stressed skin" airplane structures centers around the problem of stiffening the relatively thin sheet which must be used The most common method of stiffening involves the attachment of separate stringers, frames, or other members, in such a way as to reduce the "unsupported" areas of thin sheet In many cases, however, it is possible to make the sheet serve as its own stiffener by forming a *bead* in it This type of design is of course well adapted to quantity production, as it eliminates the use of many small members, as well as the riveting or spot-welding operations that would be required to attach them.

Since the bead, unlike the separate stiffener, destroys the "planeness" or continuity of the sheet, it must be used with caution. This is perhaps one of the reasons why it still seems to be necessary to develop beaded structures by the "cut-and-try" process A few simple principles can be stated, however, and their observance will at least eliminate some of the more inefficient applications of beads.

Types of Loading

The two main types of loading for which thin sheets must be stiffened are *normal* loading (load applied at right angles to sheet) and *compression* loading (compression stresses acting in the plane of the sheet) Both types tend to make the sheet bend out of its original plane. Since a thin sheet has very little resistance to such bending something must be done to increase the 'effective thickness" of the sheet.

The presence of *compression* stresses in the plane of the sheet causes a "column" action tending to buckle the sheet To obtain a relatively high buckling stress the sheet must be broken up into narrow panels by means of stiffeners or beads The ultimate strength of such a compression panel will then depend largely on the column strength of the stiffener or bead, which in turn involves two types of column failure.

In column failure of the primary type the action is one of bending over an appreciable distance (between supports) Hence the objective is to increase the moment of inertia (or radius of gyration) of the cross-section This indicates the use of a *deep* bead, which would require a large radius But column failure of a "local" or "crushing" type is also possible The objective in this case is a low value of R/t (bead radius over sheet thickness), indicating the desirability of a small radius The optimum design therefore involves a compromise in which the strength against each type of failure is approximately the same

Compression Stresses

In the case of pure compression stress it is taken for granted that the bead should be placed in the direction of the stress, to do otherwise would make matters worse, as shown in Figure 1 Figure 2 shows the correct use of a bead for the case of pure compression Note that a flanged edge (Figs 2b and 2c) serves much the same purpose as a bead. Figs. 2b and 2c also illustrate "external" and "internal" beads, respectively The choice between these two types is largely a matter of production considerations

Before taking up general types of loading, it might be well to emphasize the fact that wrinkles in flat sheets are caused entirely by *compression* stresses and not by tension stresses The fact that the maximum compression and ten-

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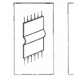

Fig 1—Bead normal to compression stress (no good)

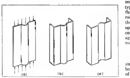

Fig 2—Beads parallel to compression stress (O.K.)

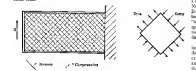

Fig 3—Shear beam

These two papers covering widely-differing aspects of a single subject provide an illuminating discussion of beads as used to strengthen sheet metal in aircraft construction all the way from basic theory and design problems to the most practical and economical methods of forming such beads.

Hydro-Pressed Beads

The technique of forming beads in sheet metal for greatest efficiency and economy.

By J. A. Petrie, *Lockheed Aircraft Corp*

THE words external and internal as used in this paper have reference only to the design of the bead produced by rubber forming in a hydro-press It must be made clear in the beginning that hydro-press forming is accomplished with the aid of rubber under pressure, which causes the sheet metal to flow over either zinc, masonite or steel form blocks

Internal beads are formed into a block while external beads are formed over a block, or an internal bead is one that is formed by pressing the material into the valley or groove in the block, as shown in Fig 2. An external bead is one that is formed by stretching the material over the crest of a half round strip placed on the block, as shown in Fig 1

In the actual forming of the beads the following conditions prevail and account for the difference in forming internal and external beads On the downward stroke of the ram of the hydro-press the rubber strikes the high point X (Fig 1) locking the metal to the form block at these points As the ram continues its travel this locking is extended over the entire bead thus causing stretch to take place between X and X and in the direction of Y and Z in Fig 1

In Fig 2 this same locking action takes place at points C - C which means that the metal between C - C has to stretch to form to the depth D Therefore, the elongation is obviously different in each case

It may be noted that the depth to width ratio of an internal bead should be 1 to 4.47 Another way of describing the bead is to say that the radius of the bead should be three times as great as its depth See Fig 3

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Fig. 1—External beads

Fig. 2—Internal beads

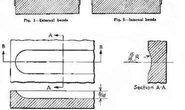


Fig 3—Radius of bead

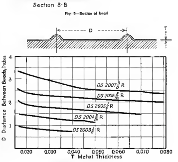


Fig 4—Distance between beads

Ten-fold Expansion

Further details on how Eclipse Aviation prepared for defense by expanding its facilities

By Sidney H. Webster, *Eclipse Aviation Division, Bendix Aviation Corp*

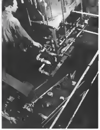


Fig 1 Continuous heat treating of starter clutch barrels. To expedite production of parts requiring heat treatment, additional heat treating furnaces of the continuous belt conveying type and continuous pusher type are used.

Part II

TO obtain maximum production output from machine tools, it has been found that by heat treating steel parts to obtain the best machineability for a particular operation, higher operating speeds and increased cutting tool life could be obtained and setup time correspondingly reduced. To provide the necessary heat treating processes for these machine operations and to expedite the rapidly increasing production of parts requiring heat treatment, additional large heat treating furnaces of the continuous belt conveying tytpe and the continuous pusher type have been obtained. (Fig. 1.) By this continuous method of heat treating, sufficient parts can be properly heat treated to correspond with the output of the new and improved machine tools, thereby maintaining a continuous in-line production system without the subsequent delay in machining operations of heat treated parts, which was previously present due to the former types of heat treating equipment

The additional advantages of the continuous type heat treating furnaces are atmospheric control to prevent scaling and decarburization, a decrease in the amount of distortion during hardening, and the elimination of pickling treatments to remove scale formed during the hardening operation. The use of automatic temperature controls and recorders which are calibrated monthly insure the uniformity of the heat treating operation Since the micro-structure and hardness of the steel determine machineability rate, and also conditions of surface finish, intermediate heat treating operations have been incorporated between the various machining operations in order to obtain improved surface finishes and higher production output for machine tools For example, with steel in its normal structure the finish of gear teeth is satisfactory for normal purposes, but does not meet the rigid requirements of the inspection department. Therefore, by introducing a special box annealing operation before finished cutting of the gear teeth, Eclipse has been able to obtain the super finish on the teeth, which could not have been obtained without the intermediate treatment In order to minimize distortion and hardening and in order to prevent movement of the metal during the aging period after finished machining, stress-relief-anneal operations have been introduced between the rough cutting and the finished machining operations

Although expansion of heat treating facilities was one of the major problems involved in increasing production output of the Bendix plant, installation of the many new types of heat treating furnaces and equipment have eliminated what might have previously been termed a bottleneck thereby increasing production output of the entire plant

Quality Control

The fundamental requirements of aircraft accessory equipment are dependability, light weight, and compactness To achieve the high accuracy, quality, efficient operation and interchangeability of integral parts, an exacting inspection and effective quality control system are essential A rigid inspection and quality control system not only insures the manufacture of dependable equipment at minimum cost, but also provides increased production output

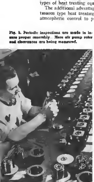


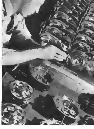
Fig. 5. Periodic inspections are made to insure proper assembly. Here air pump rotor and clearances are being measured.

Fig. 6 Starter clutch breakaway test. All units are subject to rigid test procedures under service conditions.

Fig. 7. Test measurement during machining of Eclipse experimental accessory gear box housing in the Development Department.

Fig. 2 New and improved inspection equipment has been installed to facilitate inspection and assure accuracy of machine parts. The Gisholt Dynetric Balancer is here shown balancing a generator armature.

Above: Fig 3. Assembling a generator armature.



Above right: Fig 4. Direct cranking electric and inertia starters being assembled in the Eclipse Assembly Department.

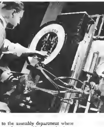


Fig 8 Experimental engine driven hydraulic pump undergoing a performance test in the Experimental Laboratory

The inspection and quality control system employed by Eclipse Aviation in the fabrication of detailed parts may be divided into three classifications inspection of purchased parts and raw materials, processing of parts, and gauge and tool inspection. All purchased parts such as ball bearings, springs, commutators, are 100 percent inspected by trained personnel and must be in accordance with specifications and conform to dimensions as specified on Eclipse drawings All raw material such as castings, forgings, bar and sheet stock, are subjected to both physical, chemical and micro analysis by the metallurgical department All other raw materials such as gaskets, oil seals, etc, are purchased from an approved vendor list and subject to inspection by either the metallurgical or production inspection departments

To assure production of finished parts in accordance with specifications and drawing requirements, all machine tools and fixtures are carefully insperted prior to issuance to the machine operator After the machine tool has been properly set up, a further check is made by an inspector and the first piece subsequently produced is submitted to the inspector for his approval prior to fabrication of additional parts All necessary gages required for the machining process are supplied from a tool room which is responsible for the maintenance of accurate jigs fixtures and gages. After each machining operation, parts are furnished to a departmental inspection crib where they undergo a complete 100 percent inspection, after which they are subsequently routed for the next operation

To facilitate and expedite inspection and to assure accuracy of machine parts considerable new and improved inspection equipment has been installed, foremost among which are the Gisholt Dynetric Balancer (Fig 2) for balancing rotating parts both statically and dynamically, the Brush Surface Analyzer for measuring in micro inches the smoothness of a machined surface the Toolmaker's Microscope for optical measurement of thread forms, Automatic Gear Checking Recorders, Magnaflux and Rockwell machines

Detailed inspection of parts after each machine operation assures the rejection of defective parts prior to subsequent machining, thereby resulting in a considerable saving of machine hours The use of improved inspection methods and new inspection tools has made it possible to increase the rigidity of the inspection system and at the same time adequately handle increased production requirements.

Production Assembly and Test

The mass production of precision made mechanical, electrical, hydraulic and pneumatic Eclipse aircraft accessory components has been made possible by the segregation of products and manufacturing facilities into specialized equipment classifications under the supervision of trained personnel experienced in the manufacture, assembly and testing of specific equipment (Fig 3)

After fabrication, detailed parts proceed to the assembly department where they are first assembled into the form of sub-assemblies (Fig 4) and then inspected prior to incorporation into completed units Periodic inspections are made at various stages to insure proper assembly in accordance with drawings and specificationss (Fig 5) The increased quantity of manufactured units has made it possible to segregate various types of equipment with the result that personnel have become specialized in the assembly of specific units, thereby expediting assembly procedure.

After assembly, units proceed to the production test department where all units are subject to rigid test procedures in which actual conditions experienced in service are duplicated in the test lab

(Turn to page 172)

An Engineering Attack Upon Aircraft Flutter

The author, who was loaned to C.A.A. by the Douglas Aircraft Corp., has written a basic article on a problem which is of importance to design engineers.

By Jean Wylie *Aircraft Airworthiness Section, C.A.A.*

AIRCRAFT wing and tail surfaces flutter or oscillate spontaneously when the air velocity over them can form certain critical combinations with the mechanical and aerodynamic characteristics of the surfaces. Flutter is a divergent motion commencing with small amplitude oscillations as a consequence of general dynamic instability. Flutter is to be distinguished from large amplitude oscillations due to turbulence of flow, flow break-away due to stalling, and buffeting due to slipstream or turbulence effects. These latter oscillations as well as periodic structural impulses and even gusts may precipitate the flutter of certain structural components but in general the critical air velocity for flutter is not dependent upon external impulses, except insofar as these impressed vibrations alter the structural characteristics. In smoothly flowing air the critical velocity can often be exceeded; the structure will remain in a state of unstable equilibrium until some small disturbance upsets the equilibrium and precipitates flutter.

The large number of the parameters effecting the flutter speed, the sensitiveness of many structures to relatively minor variations of certain of these parameters, the inexactitude with which the individual parameters of a structure can be evaluated, and finally the approximations of the theory of unsteady air flow make impossible the exact determination of the critical velocity at which flutter commences. Only by means of detailed numerical analyses of many flutter calculations can the necessary experience be attained to judge the relative importance of the different parameters. Obviously for each different mode of flutter a certain few structural and aerodynamic parameters are of prime importance, while the remaining parameters exercise only first order correction effects. With experience of this type in studying theoretically the flutter problem refinements in the technique of measuring structural properties are possible, so that the inexactitude of the properties of a structural surface is diminished. Finally the aerodynamic theory for unsteady air flow has assumed sufficient complications when applied to two dimensional flow that a three dimensional flow theory appears to be hopelessly complicated. Already enough experimental evidence exists, although very meager in quantity, to show that the two dimensional theory quite closely predicts the critical flutter speed, if all the parameters are accurately known.

Deterioration and Control of Flutter Parameters

Accurate knowledge of the parameters is not always sufficient assurance that some of these parameters will not vary with the age or service of the aircraft. Many incidences of flutter have occurred in aircraft which for considerable periods have performed satisfactorily prior to the accident. In general the principal parameters which vary with time are the effective and damping balance. Such temporal damping effects would seem to be confined logically to non-metallic aircraft structures. The deterioration effects in metallic structures are slow and do not materially affect the damping.

Another important temporal variation of the parameters is the change in control surface dynamic balance resulting from the addition of weight aft of the hinge line while strengthening control surface structures and trailing edges, as well as lax production tolerances on the dynamic balancing of control surfaces.

The effect of an increase in static unbalance with time is graphically illustrated in Fig. 1, which is based upon an unpublished study by R. E. Schlemmer of a large amount of statistical data and accident records on domestic and foreign civil aircraft. A lack of respect for, or a looseness of the tolerances on the proper balancing of control surfaces in production generally results in a lowering of the critical flutter speed, which is only discovered after the occurrence of several rather inexplicable accidents to a particular model, apparently due to severe acrobatics or bad weather operations. After the accidents temporary speed restrictions or grounding action until the surface balance values are improved is found sufficient to prevent further flutter accidents.

Because of these effects the separate dynamic balancing of each control surface is desirable. From a design point of view this requirement would necessitate stiff balance weight design to allow for minor weight variations. The necessity of allowing an adequate margin of safety against flutter requires the examination of aircraft structural designs to determine whether variation or diminution of the damping will eventually create an unsafe structure.

Engineering Application of Flutter Analyses

Concurrently with the design of an aircraft should be made a prediction of its flutter characteristics, including approximate numerical values of the critical velocities. By this means alone is possible a comparison of the relative flutter characteristics of the basic design and design variations. Such predictions help to determine final structural and aerodynamic properties so that the optimum possible flutter characteristics may be realized.

That such preliminary calculations may be accurately and quickly made experience in determining the fundamental parameters and estimating probable frequencies and relative damping must be attained. Because of the lengthiness of flutter calculations it is essential that approximate methods be used in this preliminary analysis, supplemented by charts that represent a statistical summary of flutter calculations. A detailed flutter analysis cannot in general be simplified to any great extent, since it is concerned not only with vibration theory but also with the principles of aerodynamics and applied elasticity.

With respect to statistical summaries it can be proved from dimensional considerations that the flutter velocity can be written in the form

$$v = k \times f \times t$$

where v denotes the critical linear velocity, f the basic reference structural frequency, and t the total chord of the reference surface. The factor k is a flutter speed factor that is a non-dimensional function of the mechanical and aerodynamic characteristics of the surface in numeric form.

The use of such a statistical analysis is justified by the success of such studies in circumventing tedious computations. It is not a surprising fact that despite the apparent complexity of the flutter equations the actual parametric dependencies are relatively simple and intuitive. These facts are brought to light in the summary charts of such statistical analyses. Fig. 2 (general chart flexure torsion flutter for large frequency ratios) is an example of such a chart for the binary case of flexure-torsion flutter. With such a chart it is a matter of minutes for the aircraft designer to estimate quite accurately the flutter speed. Similar charts already are in existence for the two binary flutter modes involving the control surface (i.e., flexure-control surface and torsion—control surface.* There is no limitation except the labor involved to extending such analyses to modes of tail oscillations.

Flutter Analysis Methods

Before the available flutter analysis methods are surveyed the adequacy of the aerodynamic theory for unsteady flow is defined. The transition from the two-dimensional flow (which has been checked quite satisfactorily by some wind-tunnel research) to the three-dimensional flutter of aircraft is complicated. As in the case of the spanwise distribution of steady flow lift distribution there are cross-coupling terms which represent the mutual interactions of each wing section upon the remaining sections. The neglect of these cross-coupling terms is necessary mathematically to minimize the complications. The theory, therefore, can only determine a first approximation. The aerodynamic span effect has fortunately been found to be very small, so that the first approximation is quite satisfactory. Theoretically, then, each section of a wing or a tail is assumed to be equivalent to an analogous section of a wing of infinite span.

General Time Effect of Flutter Parameters

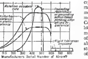
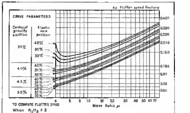


FIGURE 1

The principal feature characterizing all analyses of dynamical systems is that in place of the actual structural mechanism a mathematical model is studied, the behavior and properties of which simulate those of the actual structure. In flutter analysis it is necessary that this model be simplified to the extent that it possesses only those mechanical and aerodynamic properties which are important in the flutter theory. Such a model can therefore be made elementarily simple to facilitate rapid calculations. As further properties of the model become defined through the introduction of additional parameters, the approach to exact similarity with the aircraft structure ensues asymptotically. There are three principal methods of visualizing such a mathematical model: a sectional method, a unit body method, and a method of predetermined deflections. Combinations of these schemes are likewise possible. The choice of method is determined by the purpose of the analysis as well as by the available data on the parameters and their status, since each method is possessed of special advantages.

A wing can be represented sectionally as a series of small finite spanwise sections stiffly bound to each other and possessing their own inertia, air loads, and displacements. From a practical viewpoint the method of sections must alternate infinitely narrow sections between the sections of finite span. Either these infinitely small sections must undergo all the internal deformations of the structure and supply the internal elasticity while the finite sections remain rigid, or these infinitely small sections must be endowed with the inertia, loading and displacement properties while the finite sections undergo the internal deflections and supply the internal elasticity. This method is used in the static strength analysis of an aircraft structure because its application determines the mechanical properties of a structure. The application of the sectional method of analysis is shown graphically in Fig. 3 for approximating the vibration of a cantilever wing.

(Turn to page 160)



TO COMPUTE FLUTTER SPEED

When $f_T / f_B > 3$

$$V_F = k_F\, f_T\, t \;\frac{FT}{Sec.}$$

Where f_T is torsion freq., cpm.

f_B is bending freq., cpm

t is wing chord, ft

$\mu = \frac{m_F}{m_L}$ where $m_L = \frac{\pi}{4} \rho t^2$

m_F = wing mass per unit span

FIGURE 2 FLEXURE TORSION BINARY FLUTTER SPEED FACTOR CHART

Ground Testing Power Plants

By T. G. Hill
and A. A. Joyce
The Glenn L. Martin Co

FIVE years ago, while The Glenn L Martin Company was building its giant ocean transport, the Soviet Clipper, the technique of engine ground testing was first introduced. Thus removing one more element of worry and risk from the life of the test pilot, the method was grasped by the industry and today is gaining wide employment This article describes the technique as now employed by the Martin Co.

The primary reason for the engine ground test is the collection of sufficient data to analyze the functioning of the elements of the power plant cooling system Formerly, such testing was the first consideration of the pilot, even while he was trying to determine the flight characteristics of a new airplane.

While the analysis is accurate only for the "at rest" condition of the airplane, it is also a basis for reasonable predictions of the behavior of the cooling system under taxiing and flight conditions Secondary, but none-the-less important, reasons for the engine ground test are the opportunity to study the functioning of starting, controls and accessories, observation of vibration characteristics, accurate mock-up arrangement of the nacelle and accessory compartments, and working tests of various equipment

The dummy wing and landing gear being used to test this engine for a land plane are "engineering scenery" in the Martin procedure but the engine mount, engine and cowl assembly will go on the first airplane when test program is over. The stand is equipped with a semi-permanent fuel system.

The test equipment

The permanent part of the engine test equipment is the test stand This stand is a massive steel platform approximately 22 feet long by 19 feet wide supported on four sets of swiveling solid tire wheels for mobility and provided with screwdown jacks to lift the stand off the wheels The platform has four heavy steel uprights to provide support for the dummy wing structure upon which the power plant and nacelle are mounted

Across the end of two of the uprights is attached a permanent operating booth which incloses the various instrument panels and operating controls and provides accommodations for the engine operator and five observers For the higher powered engines, two extension supports swing out from the front of the platform to provide additional restraint against the overturning moment of the engine thrust Included with the stand is a semi-permanent fuel system which may be fitted to any engine by slight alterations of the piping and by raising or lowering the tank to give the proper static head. This system includes the necessary strainers, valves and hand pumps

The rest of the test equipment must be engineered for each power plant to be tested This engineering work is divided between the engine test group and the project power plant group

The project group engineers the engine mounting, cowling, fire extinguisher, fire wall and all service and control connections from the engine to the firewall This assembly is one of the actual airplane units and is installed on the first ship after the test program is completed If the oil system of the power plant to be tested has the oil tank in the nacelle, then the project group does the engineering for the oil tank installation

The test group does the engineering for oil tank installation, if the oil system uses a wing tank This installation is generally made with any available tank which has at least a 20 gallon capacity and which is suitable for installation in the dummy wing in a location where the length of connecting pipe and the static oil head will be the same as that on the actual ship

The dummy wing upon which the power plant and nacelle are mounted is constructed of structural steel frame work, wooden ribs and sheet iron skin. This wing section is designed by the test group and conforms in profile to the actual airplane wing The test group also engineers the attachment of the powerplant and nacelle to this structure and the attachment of this structure to the uprights of the test stand If the ship is a land plane, the dummy structure is installed on the test stand to simulate the airplane at rest on the ground and will include a landing gear in the down position If the ship is a sea plane, the position simulated will be that of the plane at rest on the water

The installation of controls and instruments in the test booth is designed by the test group. This installation is composed of four elements engine controls, service instrument panel, air and exhaust pressure panel and thermocouple panel

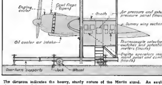
The engine controls include throttle carburetor mixture, supercharger, propeller pitch and carburetor hot air door

The Martin stand is shown here rigged to simulate a sea plane at rest on the water. The booth attached to the permanent stand includes four elements of controls and instruments, engine controls, service instrument panel air and exhaust pressure panel, thermocouple panel.

The service instrument panel incorporates the power plant service instruments and the service switches The service instruments include tachometer, manifold pressure, oil pressure, oil temperature, fuel pressure, carburetor temperature and fuel flow The service switches include ignition, starter, booster, propeller pitch control and cowl flap motor

The air pressure and exhaust pressure panel mounts a pressure gage with selector valves connected to give the exhaust back pressure at each cylinder outlet This same panel mounts another set of selector valves connected to a manometer for the reading of air pressures across two of the cylinders, in the oil cooler system, in the carburetor air system and in the accessory compartment

The thermocouple panel includes selector switches and potentiometers for the reading of all cylinder head and cylinder base temperatures, at least half of the rear spark plug elbows, and the following miscellaneous temperatures oil in and out of engine, oil in and out of cooler, air in and out of oil cooler, cylinder cooling air for two of the cylinders, carburetor air, fuel at pump and at carburetor, magneto, exhaust shrouds, nacelle skin next to exhaust outlets, engine mount bushing, cowl flap motor and accessory compartment.



The diagram indicates the heavy, sturdy nature of the Martin stand. An engine is shown mounted for testing

The test procedure

Then the stand is complete and ready for operation, it is pulled from the shop by a tractor and set up on a remote part of the plant apron where the wind will not be affected by the buildings and the slip stream will not disturb other plant operations After the engine has been turned over several times by hand to clear the cylinders of oil, the engine is started and allowed to warm up at 800 to 1000 r p m.

All running of the engine on the test stand is done with the propeller in low pitch, the carburetor mixture control at full rich and the supercharger in low blower Except during the cowl flap tests, the cowl flaps are kept full open When the oil has reached the required temperature the engine is operated for short periods of time at various speeds up to the take-off r p m During this test the engine is watched closely for any mechanical malfunctioning and excessive vibration or temperature If everything runs smoothly during this mechanical functioning check, the engine is stopped, the oil changed and the oil strainer examined for any indications of excessive wear The engine is again started and, after proper warm-up, is run at the take-off r p m long enough to adjust the low pitch propeller blade setting to give the proper take-off manifold pressure

The cooling tests are made at 200 r p m increments in speed from 1000 r p m to as high a speed as the engine may be run without exceeding the maximum allowable temperature. Each run is made until the temperatures stabilize or until the maximum limit is reached. As the standard requirement for ground cooling is that allowable temperatures shall not be exceeded at 60 percent of the normal rated r p m, the first cooling run is made at this speed If cooling is satisfactory, then runs are made at the other speeds, however, if the allowable temperatures are exceeded at 60 percent rated r p m, then corrective steps are taken before the cooling tests are continued. During all cooling tests complete temperature, air pressure, and exhaust back

(Turn to page 150)

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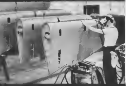

TAILS—finishing tail assemblies, Goodyear-built for Martin B-26 bombers.

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SPECIFY GOODYEAR AIRPLANE TIRES, TUBES, WHEELS AND BRAKES

Warplane Specification Engineering

Complex problems involved in submitting proposals or participating in design competitions for military projects

By Peter A. Beck, *Specifications Staff Engineer,*
and Richard H. Bubb, *Assistant, Lockheed Aircraft Corp*

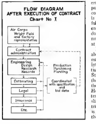
An earlier article Airplane Specification Engineering, AVIATION, September, 1941 primarily dealt with specification work for civil and export sales.

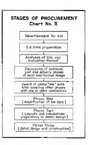
ALL military projects are coordinated by the airplane Specification Engineering Group from the time the management decides to submit a proposal or to participate in a design competition (Chart I)

Since the airplane specification is the summation of the airplane as finally conceived, the airplane specification group is a logical focal point for the various phases through which the airplane evolves It functions as the clearing house for the engineering department during the progress of design and construction.

In view of the fact that the military agencies must maintain stores to supply repair bases for airplanes in widely distributed regions, it is vitally necessary that a minimum of aircraft standards and parts specifications be promulgated and that these standards be maintained in order that ready repair and replacement are possible This requirement also applies to materials of construction such as sheet tube bolts, ball bearings, or innumerable items, or equipment or finishing materials, so that if a part is damaged, repair can be effected at any base using substantially the same materials as incorporated in the airplane in the plant of the manufacturer even though a different vendor is involved. It must be appreciated that some airplanes are in service for a period of ten years or more. Obviously, if each manufacturer were to machine his own bolts, have special screws, and provide his own particular clamps when a "standard" part is available, the problem of maintaining these airplanes in service over the several years life expectancy would be magnified many times Thus, it is necessary that requirements and regulations be established so that the materials of construction and standards for detail parts and accessories be stabilized and standardized so that all participants in a design competition can know in advance what to expect by way of not only existing specification requirements but, what is of more importance, requirements that are in the process of being promulgated and which will probably be put into effect by the time the competition is announced. The detail methods followed in procuring military airplanes for the Air Corps, Navy, Coast Guard, or Marine Corps are very similar, as required by law This article deals with typical procedures which are followed during the execution of an Air Corps contract.

When a new airplane type is believed necessary by our Air Corps, the specific requirements relating to the proposed airplane are set down in a type specification describing what is desired in the way of performance, and all of the other functions which the airplane must possess for Air Corps use The number of persons in the crew, the amount of armament to be carried, the location of the guns, sighting devices, bombs and bombsights will be stated and installations (for example, power plant) will be made in accordance with certain prestated requirements (as published in specifications or handbooks) or as modified by the particular type specification





in question. Accompanying the specification will be the necessary major drawings illustrating the configuration of the principal items which the contractor must install or equipment or material which will later be installed by the government A number of forms also accompany the specifications establishing the condition under which this competition is open, laws to be enforced during the fulfillment of the contract, with references made to specification bulletins, documents, etc, to which all participants must subscribe or make exception to at the time the bid is made

Let us assume that the data described above have arrived in our plant, the management having decided that we are interested in participating in the advertised competition. The Specification Staff Engineer is provided with all of the material which arrives, including the government's letter of transmittal He reviews all of the material as to content and completeness according to the shipping notice, and any additional material relating to the particular proposal is requested A letter is then written for the Chief Engineer's signature transmitting applicable portions of the material to the various groups concerned (such as the Aerodynamics Group) with a statement outlining the company's position in regard to this particular competition and a statement of what is desired The airplane to be submitted may be a modification of an existing type already in production or which has been in production; it may be similar to an airplane which a competitor is making, or it may be an entirely new design for which no prototype appears to exist

The design of an airplane or alternate designs are usually proposed in very sketchy form These are reviewed with the Chief Engineer, the Chief Project Engineer, and others, and certain recommendations are made to the Chief Research Engineer.

Obviously, at this time there are only small scale drawings of the various designs contemplated and a brief description usually in specification form giving the characteristics of the various airplanes At this stage, typical sections are drawn illustrating the method or construction to be followed, the wing panels, the center section, the fuselage, tail surfaces, alighting gear, etc, which are reviewed by the structures group, the production experts, the weight group, and the estimation department These drawings provide a basis for estimates of weight and cost, and balance calculations to verify that the first approximations on the location of the wings, tail surfaces, engines, etc, are correct After the design group evolves details of the flight station, bombardier's station, bomb bay, gun emplacements, radio control room power plant, etc, the weight group, the estimating department, and the specification engineer have accessible these new designs so that their work can proceed as the various designs evolve Meanwhile performance calculations are carried out in great detail, the purpose of which is to establish the accuracy of all performance predications and to demonstrate by calculation that the various designs proposed will be satisfactory airplanes It is frequently necessary as soon as a design is crystallized to build a small scale wind tunnel model of the proposed airplane or a portion of the proposed airplane, to investigate drag, turbulence, or air flow.

Very careful attention must be paid to the emphasis which the government places on certain aspects of the design For example a pursuit ship has quite different requirements from a trainer Therefore, high speed may be 30 per cent of the total evaluation in one airplane and only 10 per cent of the total evaluation in another There are as many as ten factors each with a different weight or value which must be followed by the designer as the criteria for developing the airplane desired from that competition

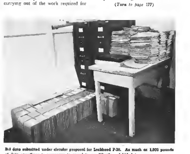
The government has recently divided the development of a new type into three or more stages (Chart II) Normally, Stage One is the design data described briefly above. Stage Two is material for general design and release by the Procurement Agency Stage Three is detail design and construction It can be expected that if the various designs submitted by the various contractors fail to meet the desires of the Air Corps engineers, the project is dropped If on the other hand, one or more designs appear meritorious, an award can be made for preliminary material and contracts let for Phase Two The bidder (or bidders) succeeding in reaching the second phase will be given a certain sum of money to build a mockup and to engineer ready for detail design and construction of the airplane or airplanes chosen by the Air Corps

When Stage Two is reached, the project is headed by a Project Engineer and he will be given a number of men of considerable experience whose choice shall anticipate that they become the group engineers in the event Phase Three, the construction of the airplane, is finally entered upon These men will proceed to study available materials of construction and methods of handling these materials to arrive at the most satisfactory design compatible with the facilities of the manufacturer, the practical requirements of the airplane, and the status of the art

To return now to Phase One, between 60 and 90 days are available for the carrying out of the work required for the first submission of data. Obviously, close coordination is necessary and the people immediately concerned must be the minimum in number and the most skillful designers and coordinators that the company has at its disposal Decisions must be based on careful, factual analyses and questionable items are discussed with various experts within the company An idea of the amount of work involved may be gained when it is realized that as much as 1,000 pounds of data are submitted to complete the requirements of Phase One on an airplane of medium size Performance analyses, for example, on a new airplane will sometimes involve 300 pages of closely typed material Full knowledge of the Air Corps Handbook of Instructions for Airplane Designers and many associated bulletins, specifications, etc, are required.

The weight department brings to bear its experience gained in airplanes of similar configuration Similarly, the estimating department in determining the cost of the first airplane and the plotting of the curve which will amortize the tools, engineering costs, and other overhead, must be kept informed of the progress of the design by the Specification Staff Engineer Obviously, if the airplane is a minor modification of an existing type, the company is in a better position to substantiate all claims and will know by experience the cost of the airplane and its component parts On the other hand if the airplane is visionary and requirements are such that the experience of the engineers must be extrapolated through some considerable

(*Turn to page 177*)



Bid data submitted under circular proposal for Lockheed P-38. As much as 1,000 pounds of data sometimes is necessary to complete amplification of bid data.

Engine Air Filters

The British have uncovered a real problem in keeping dust and sand out of their carburetors in their Middle East operations. Similar conditions might sometime confront our own Air Corps. To alleviate this problem the following work has been done.

By William K. Gregory, *Division Manager, American Air Filter Company, Inc.*

THE need for air filters for the protection of airplane motors has been recognized by the British for several years. Planes operating in the deserts of Africa are subjected to severe dust conditions when taking off in formation, and are frequently required to fly through dust clouds for a considerable length of time.

In the United States we had no acute dust problems as long as our air activities were limited to commercial planes and a relatively small number of army and navy planes which used well paved runways. With our expanding air force, however, it was necessary to use more and more temporary airports with unpaved runways. Even where paved runways are available, planes taking off in formation generally use some of the unpaved portion of the field and a considerable amount of dust is picked up by the planes in the lead which goes into the engines of the planes following.

Many problems are encountered in cleaning air for airplane motors which do not occur in the application of air filters to automobiles, trucks, tractors and large stationary Diesel and gas engines. Oil bath air cleaners which have been used with great success on other engines are ruled out immediately due to their weight and the fact that oil would spill out in maneuvering the plane. Dry type air filters would require frequent replacement, and the problem of providing these replacements during actual warfare makes them undesirable. So the type of filter which can be successfully used narrows down to the washable viscous impingement type, which cleans air by bringing it into forcible contact with oil-coated baffles.

Having narrowed our problem down to this one type of filter, however, we are still far from a solution to our problem. After years of experience it has been determined that the best all around performance can be obtained by using a viscous impingement filter which is 4 in. thick and by limiting the velocity of air flow through the filter to 350 f.p.m. maximum. A filter for an airplane, however, must be as small and as light in weight as it is practical to make it, consequently it was necessary to depart from standard practice and conduct some special research aimed at developing the most practical air filter for airplane service. It is obvious that the ideal filter would have the following characteristics:

(1) Minimum size—that is the velocity of air flow would be increased to the maximum permissible velocity, and the thickness of filter reduced to the minimum.

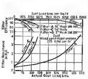


Fig. 1. Performance of a 2-inch thick filter, illustrating the effect on resistance and cleaning efficiency.

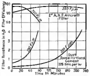


Fig. 2. Comparative performance of two 3/4-inch thick filters and one 2-inch thick filter.

(2) Highest possible average cleaning efficiency.

(3) Minimum rise in resistance with dust accumulation.

(4) Maximum dust-holding capacity consistent with maintained high cleaning efficiency and permissible rise in resistance.

We arbitrarily limited our research to two thicknesses of filter—¾ in. and 2 in.—as a thickness of ¾ in. appeared to be the minimum practical thickness and 2 in. the maximum thickness we could hope to find room for in an airplane. The tests recorded indicate the performance of the most satisfactory ¾ in. and 2 in. filters we were able to develop after making 8 or 10 test samples of each thickness which employed various types and arrangements of filter media.

Fig. 1 indicates the performance of the 2 in. thick filter at velocities of air flow of 350 f.p.m. and 700 f.p.m., and, by comparing these curves with those of a ¾ in. thick filter, the superior performance of the thicker filter was clearly indicated. It is interesting to note that on both the ¾ in. and 2 in. thick filters, the initial cleaning efficiency was higher when the air velocity was 700 f.p.m. than when it was 350 f.p.m., but that cleaning efficiency dropped much more rapidly at 700 f.p.m. with dust accumulation.

Figure 2 shows the comparative performance of two ¾ in. thick filters and one 2 in. thick filter, with an air velocity of 600 f.p.m. through the filter cell. This velocity was selected for these tests after conference with officers of the Army Air Corps who have tentatively established 600 f.p.m. as the maximum velocity they will permit on army planes. The test dust employed in the tests recorded in Figure 1, was Portland cement dust, the analysis of which is given in the Supplementary Data attached. The test dust employed in tests recorded in Fig. 2 is a mixture consisting of 95 percent foundry sand and 5 percent sharp sand which probably more

(*Turn to page* 180)

The False Horizon

An interesting study of the important problem of atmospheric haze as conducted at Stanford University

By Volney Fioch

Professor of Mechanical Engineering, Stanford University

(Now on active duty with the Navy)

MOST of the attention of aerologists in recent years has been focused on the new theories of weather analysis—the polar front theory and the air mass theory, whose consolidation into a workable forecasting system—the air mass and frontal analysis—is generally credited to the meteorologists of Norway and in particular to V. Bjerknes and his son, J. Bjerknes

The five basic principles of this analysis are briefly as follows:

1 When a mass of air lies dormant over a portion of the earth's surface it takes on the climatic characteristics of that area.

2 When this stagnant air mass does move it may travel long distances over the earth's surface and still retain the climatic characteristics of its source region.

3 When two dissimilar air masses meet, the warmer (lighter) mass overruns the colder (heavier) mass. This leads to the formation of a wedge of cold air over which the warm air moves to some very high altitudes. The front which separates the two masses is the upper surface of the wedge.

4 Clouds, rain, and other disturbances occur along these fronts. They may also occur within the air masses themselves when unusual terrain features impart motions to the mass that encourage such tendencies toward disturbances as the mass may have.

5 Phenomena such as haze, fog, dew, frost, etc., may occur within the air masses themselves

Since the most severe weather conditions in most sections occur along the fronts, it has been of vital necessity to aviation to concentrate research on this focal point in modern weather analysis. At the same time it must be remembered that some of the lesser phenomena, mentioned under heading five above, often seriously interfere with maintaining scheduled flight. Therefore, it is reasonable that investigation of their causes and of their variations with related factors should be pursued in an attempt to acquire data that may lead to an increase in ability to operate aircraft in localities where these conditions are causing difficulty

An investigation to determine the cause of one of these phenomena—*atmospheric haziness*—was recently carried out by Edward M. Fryer, Graduate Mechanical Engineering Student in the Stanford University School of Engineering, under the direction and guidance of Professor Norris E. Bradbury of the Department of Physics. Professor Bradbury teaches the Stanford course in meteorology.

In addition to seeking additional data on the cause of haze, an effort was made to determine its relationship with the following factors:

1 Relative humidity
2 Condensation nuclei density
3 Dust count
4 Time of day

The method used was to project a light beam down an open field to a photoelectric cell, and continuously measure the intensity of the beam as it varied by reason of its light scattered by the particles constituting the haze. Relative humidity, temperature, and velocity and direction of the wind were recorded. The nuclei density was obtained and recorded by an apparatus previously used by Professor Bradbury and Meeron for measuring the variation of the number of condensation nuclei in the atmosphere throughout the day

The observation hut from which Fryer made his measurements is in the middle of a large field—a location which is relatively free from unnatural atmospheric disturbances

Before examining the curves showing the results of the investigation it may be well to review briefly the modern conception of the causes of the haze layer whose upper boundary is often so sharp that aviators mistake it for the real horizon. The minute particles that have been thought to form the nuclei for condensation of the water vapor of the air and thus be partly responsible for haze and other phenomena that give poor visibility originate from the following sources:

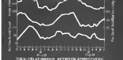


FIG. 1—RELATIONSHIP BETWEEN ATMOSPHERIC HAZE AND RELATIVE HUMIDITY

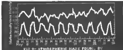


FIG. 2—ATMOSPHERIC HAZE FOUND BY FRYER WITH HIS LIGHT-BEAM METHOD

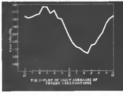


FIG. 3—PLOT OF DAILY AVERAGES OF FRYER'S OBSERVATIONS

1 Dust particles resulting from the action of winds on the earth's surface

2 Smoke emanating from industrial, commercial, and residence areas and from forest and other fires.

3 Salt remaining after evaporation of spray from oceans and other bodies of water

Dust particles have been ruled out as condensation nuclei. They have been found by many investigators to require a greater supersaturation for condensation than that which exists under any set of natural conditions. The smoke particles formed by combustion are partly composed of nitrous or sulphuric acid, and some of these will readily absorb and retain moisture. Many smoke particles, however, are not hygroscopic and will neither absorb nor retain moisture

Sea salt particles composed of sodium chloride or magnesium chloride are the greatest source of condensation nuclei, and extensive measurements by Kohler on the chloride and magnesium content of rain, snow, and fog show that these particles are carried far inland from the ocean

(Turn to page 158)

Wings For The Catalinas

Brewster takes a big sub-contracting job in full stride

By Randolph Hawthorne *Aviation Magazine*

WHEN James Brewster started a carriage factory in New Haven, Conn., back in 1810, he quickly became noted for his advanced ideas in shop organization and the excellence of his products. Today, with the experience of building three stages of transportation equipment under the Brewster name, Brewster Aeronautical Corporation carries on the tradition of fine craftsmanship in the production of the tubby, but efficient and highly maneuverable Brewster "Buffalo" fighter and the "Bermuda" dive bomber. At the same time, taking it smoothly in its stride Brewster is building wings in its Newark plant for the Consolidated "Catalina" patrol boats of Bismarck fame in a multi-million dollar sub-contracting job.

Brewster's first venture in the aeronautical field was made at the Queens plant in 1920 when the Navy awarded a contract for duralumin seaplane floats. Then, in 1932, with the Brewster name already well-known in float construction, James Work, now chairman of the board, foreseeing a more prominent future in the industry, with three associates, bought the aircraft division of the century-old Brewster Body Works, thus formally launching the Brewster Aeronautical Corp.

Until it embarked upon the production of aircraft of its own design, beginning with a light dive bomber produced in 1935 for the U. S. Navy, Brewster devoted all of its facilities to building wings, cowls, tail surfaces, etc., for other manufacturers.

Up until about two and one-half years ago, sub-contracting represented about ninety percent of its production. Today the order is reversed, and the sub-contract being performed by Brewster represents less than 10 percent of the backlog of the company.

Brewster was chosen to produce the Consolidated wings because of its established reputation as wing expert. All of the original Grumman fighters took to the air on wings built by Brewster under sub-contract. The original wing order placed by Consolidated, which has been since supplemented by additional orders, found the Brewster company in the process of expanding its facilities to produce the "Buffalo" fighter, orders for which had been placed by the U. S. Navy and the Royal Air Forces of Great Britain and the Netherlands East Indies.

To handle the Consolidated job, the company on March 1, 1940, leased the 217,000 sq ft. municipal hangar at Newark Airport. Despite the problems involved in procuring new equipment, training new personnel and transferring supervisory personnel, which was accomplished without seriously depleting the ranks of supervisors in the Long Island plant, the company quickly had the Consolidated wings, floats and braces in production and has doubled production during the past year.

The task of bringing production up to its present efficiency was the responsibility of Philip M. Stephenson, vice president of Brewster, who joined the company in 1933 as production manager. Mr. Stephenson's background in aviation manufacturing goes back to 1926 when he entered the employ of the Chance Vought Corp., rising by 1931 to manager of production planning and supply. It was under his direction that the

Overhead tracks carry rivet guns for main wing spar riveting. This method has tripled production of wing spars.

Rivet squeezing on a wing spar is made easier with this rivet gun method worked out by a foreman.

Nose rib assembly work on jigs mounted on six-inch steel pipe and workable from two sides.

Brewster company built the wings for the Grumman FF-1, SF-1, JF, J2F, F2F, and F3F fighters.

An account of some of its production methods developed under Mr. Stephenson on Consolidated PBY-5 outer wing panels, floats and braces may prove interesting.

Sheet Metal Department

Approximately 3,139 parts, together with about 200,000 rivets, go into the completed Consolidated wing panel job which begins in the Sheet Metal Department in Brewster Aeronautical's plant at Newark Airport. The entire production is divided among six departments, A to F, from fabrication of the raw metal into parts to the painting of British or U. S. Navy insignia prior to shipping the finished wing panel across the continent to Consolidated.

From Raw Storage the 24S aluminum alloy metal is taken and shaped into fabricated parts to be used in the departments engaged in sub-assembly work.

The fabricated parts are heat treated in electric salt bath furnaces. This type of furnace has been found to be the most efficient for aircraft work for several reasons. For one thing, temperature control can be maintained within a few degrees plus or minus of the allowed temperature range. For another, there is practically no temperature drop when placing the charge into the furnace due to the large volume of nitrate which is always held at the correct temperature. Furthermore, recording potentiometers are used on all furnaces as an accurate means of control, and the self-recording type instrument permits the filing of all charts. Thus,

(Turn to page 140)

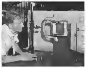
The Newark Airport plant of Brewster Aeronautical Corporation.

DELTA
DELTA
DELTA

Metal-Casting by the Antioch Process

New method has become a valuable source of aluminum and non-ferrous castings for aircraft

By Elmer J. Weinheimer, *Sales Engineer*
Foundry Division, Menasco Manufacturing Co.



Checking a complicated pattern with engineer's drawing. Note the difficult thin-wall sections and curves and contours.

X-ray of aluminum casting is useful in controlling and developing correct casting technique

Plaster molding material is poured from till-bucket into the patterns. Patterns are held in metal flasks.

DEVELOPED during a search for a better way to cast art objects, and first used outside of that field in the manufacture of tread design inserts for Goodyear Tire & Rubber Company, the Antioch Process has become a valuable source of aluminum and non-ferrous castings for the aircraft industry. Its use for this purpose is expanding rapidly

At present there are two foundries in the United States authorized to use this process on a commercial production basis: the original Antioch foundry at Yellow Springs, Ohio, where the process was developed, and the Los Angeles foundry of the Menasco Manufacturing Company, which received its exclusive license from Antioch in May, 1939

Due to the newness of the process, our engineers found it necessary to carry on considerable experimental and developing work in perfecting their foundry technique And as is the case in any new manufacturing operation they have learned the limitations and potentialities of the process through the trial and error method of actual production, as well as through the medium of research

Our exclusive license permits us to manufacture Antioch castings anywhere west of the Mississippi River, and to sell them anywhere at all Originally Menasco undertook the production of castings by the Antioch process as an aid to the manufacture of parts for Menasco aircraft engines The advantage of the process soon stimulated other people to come to our foundry with all sorts of difficult casting problems Currently, however, the facilities of our foundry are being utilized almost exclusively for the production of aircraft and aircraft engine parts although the process has a multiplicity of uses in other industries

Aircraft builders, confronted with the need for finding every possible short cut to production have discovered that complicated parts that cannot be satisfactorily cast by any other method, can usually be produced by the Antioch process The reason for this is that it permits the production of castings with practically any combination of curves contours and angles, and thin wall sections having an exceptionally high tensile strength The ability to produce these more intricately designed parts is resulting in considerable saving in tool-up costs to the aircraft manufacturer

One of the other outstanding features of castings made by the Antioch Process is their smooth finish. This, together with the maintenance of dimensional accuracy superior to that of other foundry methods, reduces the amount of machining required after the parts are received by the manufacturer. Thus, while the metal cost of the castings may be higher than those made by other processes, the saving in machining time alone more than offsets it

Because of the accuracy of castings made by the Antioch Process we find a tendency on the part of some of the aircraft engineers to ask us to hold closer tolerances than are economically feasible The plus or minus dimensions that can be maintained are dependent entirely on the shape and size of the part to be cast, and as a result our engineers do not attempt to establish these tolerances until they have had an opportunity to inspect the blue-prints of the parts

Operations of the foundry division are under the direction of V. O. Clark, graduate of the U. S. Naval Academy and post-graduate of Columbia University in mechanical engineering, who retired as a commander of the Navy in July, 1940 to join the Menasco organization Last year he spent several months at Yellow Springs, Ohio, studying the Antioch operations of that plant

To get a complete picture of the production of castings by the Antioch Process, assume that a new order, accompanied by blueprints of the parts to be made, has just been received at the Menasco foundry The first procedure, of course, is for the pattern shop and our engineering and control departments to get together and decide the most practical method of making the casting and pattern equipment

V. O. Clark (left) of the Foundry Div., Menasco Mfg. Co., and Metallurgist Frank L. Fulne discuss correct foundry technique

Representative group of parts produced by Antioch Process.

At this preliminary conference we visualize the problems connected with this particular job so, when the pattern equipment is ready for production, only slight changes may be required for best results If the order is for a relatively large number of castings, metal pattern equipment of either a match plate design or of permanent cope and drag type is made If a match plate is decided upon, shrinkage and design of the equipment is very close to and in most cases interchangeable with that used for a sand casting job, except that for the Antioch process the pattern equipment is much more finely finished If cope and drag equipment is desired, metal patterns are made singly and are then mounted in special gypsum cement matches

Upon completion, the pattern equipment is turned over to the engineering and control department which then makes the preliminary castings for layout and solution of all problems relating to gating and risering in order to obtain castings of most suitable qualifications. Before the job is released for production all problems are analyzed and checked by X-ray examination. Upon release of the equipment by the engineering department, the pattern is placed in production at a rate in excess of quantities required per month

The molding department, which is the first step in actual Antioch production, mounts the pattern upon movable dollies so that it may be readily taken from the plaster pouring stations to the point for stripping The molder places a half flask each on both the cope and drag pattern equipment, inserts the aligning pins which are made to a fit of not greater than .003 of an inch and rolls the dolly to the plaster pouring station The flask is poured with the type of Antioch plaster "mix" best suited for that particular job—allowed to "set" and then stripped from the pattern by power If a match plate pattern is used, the plate is inserted between two half-flasks and one side side poured, allowed to "set" and then turned over and the other side poured. Then both halves are stripped by power In cases where there are a relatively small number of castings to be made from a pattern, the entire pattern equipment may be made of gypsum cement with brass rods and bushings used for "locating" in assembly, and not held in flasks This method is only used where the orders are small and there is no justification for the more expensive pattern equipment. In taking the plaster casts from this type of pattern, air is used at the joint between the cast plaster and the pattern In most cases the methods of coring are identical with those used in a sand foundry However, prints and locating devices for setting the cores are made to insure greater accuracy and no possibility of errors in placing cores. After stripping the plaster cast from the

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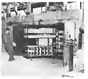


Plaster molds are dried in ovens to insure accuracy of casting and to prevent blow holes in metal

Molds are inspected for fit before going to mold assemblers.

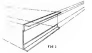
Patternmaker fits gates and risers into cope and drag pattern. Next table holds core boxes for casting

The gates and risers are cut from castings

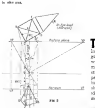
Aircraft Drawings in Perspective

Ideas on an improved drawing method for conveying ideas to shop and sales departments.

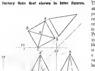
By R. S. Rose *Equipment Design Engineer Lockheed Aircraft Corp*



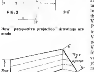
A perspective drawing in which distortion is obvious.



Perspective drawing which is an improvement over that used in Fig 1, but less satisfactory than that shown in later figures.



How perspective projection drawings are made



Horizontal Perspective Division

TO the majority of aircraft draftsmen the term "perspective drawing" suggests a type which contains a goodly number of unknowns and one with which there should be no experimentation. Actually, a correct understanding of the simple fundamentals of perspective will open up a field of drawing hitherto seldom used and one which should prove valuable in conveying ideas to shop departments, sales departments and all concerned

Several methods of constructing perspective drawings are in use today and it is the purpose of this paper to explain and point out the reasons for each. The first method to be described is one in which the Vanishing Points are picked at random. This method usually results in ineffectual drawing, because only the draftsman skilled in perspective is able to locate these Vanishing Points without introducing distortion in one or more planes. For this reason this method of perspective development is not recommended. Fig 1 illustrates a part drawn in perspective in this manner and the obvious distortion should be noted

Another method commonly used today is to place the object in plan view at a predetermined angle with the Picture Plane, P.P.,—see Fig 2. Establish the Observation Point, O.P., in the plan view, the Vanishing Points, V.P. are then located by connecting the P.P. with lines parallel to the respective sides of the object. Project the V.P.'s to the horizon in vertical elevation, thereby establishing the vertical V.P. Project extremities of the object from the plan view to the vertical elevation. Note that any point thus projected is actually the intersection of a ray from the Observation Point, O.P., to this particular point with the P.P. Establish the vertical measuring line at the point where the plan view of the object crosses the P.P., determine the relationship of the object with the horizon and draw horizontal perspective object lines. To establish the vertical perspective scale, mark off on the vertical measuring line the correct number of units, (4, 5, & 6), then project to respective Vanishing Point (see Fig 2). To establish the horizontal perspective scale, mark off on the vertical measuring line above the object the same number of true scale units as the object is long. Connect the last unit with the end of the object closest to the V.P. Project rays from Vertical Measuring Line to V.P., and project their intersection with diagonal vertically down the face of the object, thus determining perspective dimension in this plane

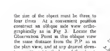
The above method produces in a relatively easy manner a true perspective. However, there are several objections to this method which should be pointed out. First, to eliminate out-of-scale perspective distortion, the O.P. must be placed far enough from the object to enclose the extremities within a 30 deg angle. This ratio between the size of the object and the distance of the object from the Observation Point bears a definite value of from $\frac{1}{3}$ to $\frac{1}{4}$. If this suggestion is carried out, the perspective distortion will be greatly lessened. With this particular method of development, the V.P.'s then locate themselves at excessively great distances from the object itself, requiring either a large piece of paper or in some cases V.P.'s established on the proverbial sky-hook. For this reason a different type of perspective has been investigated and is outlined below

When using this new method, which may be called "perspective projection," the object to be drawn is placed in the plan view at a predetermined angle with the P.P. Locate the O.P. at any point desired, keeping in mind that the relation of the distance from the object to the size of the object must be three to four times. At a convenient position construct an oblique side view orthographically as in Fig 3. Locate the Observation Point in this oblique view the same distance from the P.P. as in the plan view, and at any desired elevation in respect to the base of the object. In both oblique and plan views project points on the object on to a straight line with the Observation Point until the line intersects the P.P. Project this intersection horizontally for the oblique view and vertically in the plan view until they intersect, thus establishing the various points in true perspective

If it is desired to construct true perspective scales for this method, and actual projection from plan and oblique views is impossible or undesirable because of lack of information, the following methods may be used. Referring to Fig. 4, a method of constructing a vertical perspective division may be outlined as follows: Having one vertical measuring line in the Picture Plane which is true scale, divide a line of similar perspective height into the same number of equal parts by the diagonal method. Connect the respective points thus establishing vertical perspective scale lines

To construct horizontal scales (Fig 5) draw any line AB from top corner of known true spaces one less than the length of the object perspectively. On the opposite end of the object construct the line CD and lay off the same number of spaces, but from the bottom of the vertical face of the object. Connect extremities of diagonal lines with the opposite ends of vertical reference lines, BE and OF. Draw lines through each element parallel to the original connecting line. Draw a diagonal EF on the face of the object using as opposite corners those not used by the intersection of the original equal space diagonals. Having drawn this diagonal, intersect it with perspectively horizontal lines which are drawn through the corresponding divisions at each end of the figure. At the intersection of these horizontal lines and the diagonal on the face of the object erect perpendiculars. These lines then are correct horizontal perspective scale divisions. Various ramifications of these methods of constructing true scales can be used to subdivide perspective scale dimensions into smaller units as illustrated in Fig 6

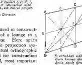
All of the foregoing methods are oblique perspective, in other words, the object is so placed that no face is parallel to the Picture Plane. In parallel perspective one face is placed parallel to the Picture Plane. Only the third of the three methods described above can be used for this type of perspective. Interior views can be rapidly and correctly constructed by this method. Fig 7



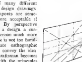
Vertical Perspective Division

illustrates the method used in constructing an interior view of a lounge in a modern transport plane. Here again the advantages of this projection system are unfolded. Actual orthographic drawings can be used for construction of the perspective and, most important of all, the finished drawing is an exact reproduction of what the eye sees. A very useful adaptation of this method can be used to construct true scale perspective drawings of many different types of preliminary design drawings. Complicated design layouts are sometimes clearer and more acceptable if presented properly. By perspective visualization of such a design a customer can reach a decision much more rapidly, especially if he is not too familiar with the intricate orthographic drawing necessary to convey the idea

After the aircraft draftsman becomes sufficiently familiar with the principles involved in perspective drawing he will find it easy to render perspective free hand sketches having correct proportion and correct Vanishing Point locations. A little practice with this perspective projection method will yield rich benefits in the pictorial representation of ideas.

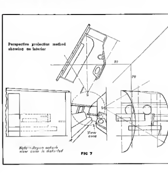


Double Expansion



Triple Expansion

Double and triple expansion



Surface Preparation

For Painting Aluminum Alloys On Aircraft

For treating aluminum alloy surfaces prior to painting, "Alumilite" and "Alrok" have undergone exhaustive tests

By Robert I. Wray

Aluminum Research Laboratories

INDUSTRY is making a concerted effort to speed up the production of defense materials. Nowhere is this effort more important than in the aircraft industry. Although painting is a minor item in the assembly of airplanes and motors anything which can be done to shorten this time is important. Painting practices have been improved, particularly by the development of quicker drying materials. However the surface preparation of aircraft to hold paint is still a time-consuming operation, and any reduction in the time and expense required for this operation is highly desirable. In this article is described the testing of two processes to fit them for use in aviation.

EXPERIENCE has demonstrated that when wrought or cast aluminum alloy parts on aircraft must be given paint protection, the service rendered by the paint is affected in an important way by the treatment given the surface before painting.* Anodic coating, either by the chromic acid process or the Alumilite* process, has become almost standard for this purpose. However substantial equipment is required for anodic treatment on a large scale. Chemical treatments have now been developed which do not require electric current for their application, and which can be applied in a short time, thus simplifying the aircraft and the aircraft engine manufacturer's problems.

Test Methods

Extensive tests of painting practices for wrought alloys were carried out in specially constructed equipment at Edgewater, N. J.* The testing apparatus consisted of several large tanks which were alternately filled with water from the Hudson river and then drained. At this location the river water contains about half the salt concentration found in sea water and in addition contains considerable pollution from industrial works. The aluminum alloy test pieces were mounted in these tanks in such a manner that they were completely immersed when the tank was full. A portion of each specimen was also continuously immersed and consequently some marine growth accumulated on this area. Box type specimens, open at the bottom to permit free entry of water, were employed; the boxes were coated on all faces. In most cases the boxes were primed before they were assembled by riveting.

Another type of test piece was employed for tests conducted at Point Judith, R. I. In these tests, box girders made of two wrought aluminum alloy

(*Turn to page 144*)

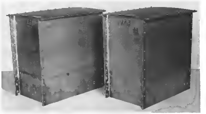
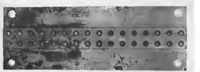


Fig. 1. Appearance of painted aluminum alloy 17S-T boxes after five seasons' exposure in Edgewater tank. Box on left given Alrok treatment, and box on right treated with Alumilite, prior to painting.

Fig. 2. Painted aluminum alloy 53S-T panel as it appeared after 2¾ years of exposure in Wilmington Tidewater test. Section on top given Alumilite treatment, that on the bottom, Alrok prior to painting.



* The Alumilite process is protected by patents owned by Aluminum Company of America.

Mass Production of Aircraft Clamps

Bendix engineers devise improved methods to meet emergency demands for clamps

By R. R. Harrison, *Superintendent, Clamp Dept., Bendix Aviation, Ltd.*

Twenty-two-ton Marshalltown press piercing blanking and magazining clamps Note partly filled magazine below machine

DEVELOPMENT of hydraulic and electrical actuating devices for operation of such airplane units as retractable landing gears, wing flaps, bomb doors, gun turrets, etc., has resulted in extensive hydraulic plumbing and electrical conduit tubing installations in modern airplanes

These lines, as well as fuel and oil lines, required specialized clamps for attachment to the airplane structure Such clamps had to electrically bond the tubing to the structure and cushion it against vibration. The present defense program has resulted in a demand for such clamps far exceeding any previous capacity and the mass production of special aircraft clamps has been an interesting sidelight of the present production program

Bendix cushion clamps incorporate a Neoprene cushion that is permanently thermo-welded to the metal clamp A light strip of metal is then riveted to the clamp body to act as an electrical bonding agent between the tube carried in the clamp and the metal structure to which it is attached The result of this design is a clamp of low weight, better electrical conductivity, quicker assembly and permanent tightness But many manufacturing problems were encountered in placing this clamp in production To overcome them it was necessary for Bendix engineers to develop a number of entirely new machines, and to build a complete set of specialized dies and fixtures

The company is producing tremendous quantities of bare and thermo-welded cushion clamps each month, and is capable of increasing its output indefinitely

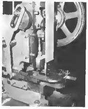
With seven punch presses ranging in size from 1 to 22 tons capacity as the basic equipment, the company developed a battery of special machines almost entirely automatic in operation.

Most important piece of equipment—the construction details of which are a trade secret—is a multi-stage piercing shearing and forming die set-up in a Marshalltown punch press that, feeding four strips of stock at a time, turns out 48,000 completed Alclad clamps an hour

Bendix tool engineers designed all the dies for each of the approximately 300 different type and clamp sizes the plant produces

In addition to the dies, the machines developed were A one-ton, magazine-fed fully automatic peening machine to attach the bonding strip and peen the upset eyelet on thermo-welded clamps, three air-driven sub-presses for piercing and shearing AC 735 loop-type clips, an automatically fed cut-off machine for cutting the Neoprene cushion material to various lengths a slitting machine for slitting rolled aluminum to desired widths, an automatic curling machine for curling clamps of all sizes, from an eighth of an inch to four inches in diameter, a conductivity testing board, with a pneumatic clamping device, designed and built around the Leeds

(Turn to page 169)



Automatic magazine-fed 6-ton Waterbury Farrell punch press forming lug type clamps.

Bendix Aviation, Ltd., aircraft clamp conductivity and diameter test board with Leeds-Northrup Kelvin Bridge Ohmmeter.

Pneumatically-driven Bendix-built curling machine for stainless steel thermo-weld loop-type aircraft cushion clamps

MICRO SWITCH
Announces a Price Reduction
on its "Type H" Aircraft Switch

Today—just one year after the announcement to the industry of our "Type H" Aircraft Switch—we are announcing a price reduction on this fine switch.

The new switch—which was developed after months of research and collaboration with leading aircraft engineers—has met with instant acceptance. Today, as a result of the economies in a rapidly increasing production, we are able to announce this price reduction.

Since reducing prices whenever possible is part of our basic policy of doing business, we are doubly pleased to acknowledge in this way the fine cooperation of leading aircraft engineers in the design and development of the "Type H" Micro Switch.

Micro Switches Are Now Being Used By: *Beech · Bell · Bellanca · Bendix Aviation Ltd · Boeing · Brewster · Consolidated · Curtiss Wright · Douglas · Eclipse Aviation · Fleetwings · Lockheed · Glenn L. Martin · Mercury · North American · Vega · Vought Sikorsky · Vultee · Waco · Cessna · Goodyear Air Corp · Fairchild · Republic · Grumman · Lear Avia · Stearman*

. . . **As** limit switches on motor movement on propeller synchronizing, propeller pitch, wing flap operation, landing gear control, etc. . . . Signal switches on doors, landing gear position, propeller pitch position, landing ski position, "tell-tale" instrument indications, etc., etc. . . . Automatic fire extinguishers, interlocking safeties for throttle and landing gear control, safeties to prevent retracting landing gear when plane is on ground, or to prevent firing machine guns when pointed at any part of the plane . . . Many applications on synchronizing machine gun fire, counting rounds fired, bomb dropping and bomb rack equipment . . . Radio equipment.

Micro Switch is a trade name indicating manufacture by Micro Switch Corporation.

MICRO MS SWITCH

Manufactured in FREEPORT Illinois, by Micro Switch Corporation. Sales Offices: New York, Chicago, Boston

HARDEST WEARING SURFACE *in Industry*

Essential in the Cyclone engine, with a flight life of 2,000,000 miles, is the thin layer of nitrided steel on the inside of Cyclone cylinder barrels. Hardest wearing surface in industry, this internal "armor" of diamond-like hardness is needed to withstand the wear of piston rings travelling at terrific speeds under high temperatures.

Requiring 50 hours of heat treatment at temperatures up to 975°F., nitriding hardens the steel to extend immeasurably the service life of the cylinders, as well as gears, shafts and other parts, and enables them to stand up under emergency conditions.

Wright today employs the most extensive battery of nitriding furnaces in America to produce in quantity the "armored" parts for its monthly output of engines totalling nearly 2,000,000 horsepower.

WRIGHT *Aircraft* **ENGINES**

WRIGHT AERONAUTICAL CORPORATION · PATERSON, NEW JERSEY

Division of Curtiss-Wright Corporation

Aviation And The Duration

By Selig Altschul

THE correlation between the duration of the war and the outlook for the aircraft builders was again vividly illustrated by recent events. President Roosevelt's warning that "the task of defeating Hitler may be long and arduous," was taken as an indication that the war may last a long time. This found immediate reflection in the market-place where aircraft equities enjoyed a resurgence of popularity with many issues reaching new highs for the year.

The longer the war—the longer the period in which steadily increasing aircraft deliveries may be made with consequent favorable effects on earnings despite rising costs and higher taxes—so runs the reasoning supporting price appreciation in aircraft stocks.

Analysis of earnings reports, however, clearly shows that the era of soaring profits in the aircraft industry appears to be at an end. It is true that the industry as a whole experienced outstanding gains in earnings during the first half of 1941 and will undoubtedly continue to record impressive gains throughout the rearmament period—but the earnings increment rate will not be as rapid as formerly. Further, it is likely that profits will not parallel the rising volume of deliveries.

This phenomena may be attributed to a number of important factors. Rising wage costs, higher taxes and increasing material costs, are the major elements which can be expected to throttle any accelerated profit margins. Adjustment charges due to expansion programs, although non-recurring, may be considered an important near-term influence. From this point on, virtually all deliveries will be for the account of the United States Government.

In reviewing the various rising cost elements, it becomes evident that they represent factors over which management has but little or no control. As long as deliveries are in the ascendancy, this condition remains unnoticed. However, as production schedules decline, this cost rigidity will deflate earnings at a faster clip than any rise in profits previously experienced.

Additional wage increases again appear in the offing. Negotiations to stabilize wages in the aircraft industry, if consummated under pending proposals, will add an estimated $600 million in labor costs, the major part of which may be absorbed by the Government through contract adjustments. Once established, however, these wage scales have a tendency to resist any downward revision. Absent from any aircraft wage scale is the arrangement present in Canada where railroad wages along with factory wages have been tied to the cost of living. No such orderly adjustment is in prospect for the aircraft or any other major industry in the United States.

As indicated in our June, 1941 presentation, a total of 66 percent of the selling price of the finished aircraft is consumed by wages. While consistent gains have been made by aircraft workers, other industrial groups have shown even greater improvement. According to the Department of Labor, aircraft workers averaged $35.48 per week and 79.9 cents per hour for the month of June, 1941. The automobile industry on the other hand, for the same month, paid $45.68 and 106.5 cents respectively. The durable goods industry as a group, for the same period, averaged $36.89 per week and 82.2 cents per hour. In terms of contrast, the automobile workers increased their weekly earnings by 30.6 percent over the same period a year ago, while the gain by the aircraft group averaged 13.1 percent for this same period. The automobile industry probably requires greater skilled labor—hence one reason for the spread. However, as the aircraft industry becomes more thoroughly organized by the unions, further pressure will be exerted toward upward revisions of payrolls in the group.

At this writing, the 1941 tax bill appears to be on its way toward final enactment. As rewritten in the Senate, the aircraft industry may look forward to a basic combined normal and surtax rate of 31 percent. Further, excess profits rates are increased 10 percent with the companies retaining the alternative of determining excess profits on the basis of invested capital or average earnings. The over all effect of the current tax bill appears to have been well discounted. In fact, it may now be found that a number of aircraft companies may have made liberal provisions for taxes during the first half of this year which will require adjustments in subsequent periods.

Interestingly enough, an analysis of statements of 275 industrial companies by the National Industrial Conference Board disclosed that six aircraft and parts manufacturers set aside 67.5 percent of earnings for taxes in the first half of 1941 as contrasted to 21.1 percent in the same period a year ago. This resulted in a decrease of 6 percent in net earnings in the first half of this year, although before taxes earnings were up 127 percent. The aircraft group established higher tax reserves than for any other industry; the average for the 275 companies being 51.6 percent.

While the current tax bill is rapidly becoming a known factor, another and stiffer tax bill is reported in the offing. As soon as the 1941 tax law is placed on the statute books, it is indicated congressional groups will immediately begin preparation on next year's tax bill.

Contributing to lower profit margins as well, is the bulk of deliveries now to be made to the United States Government. The tendency appears to place future orders of the cost-plus-fixed-fee variety—which does not carry with it a guarantee of a net profit in the amount of the fixed fee. This type of contract does, however, shift increased labor and material costs to the Government. Frequently quoted is the experience of Douglas. For the first half of 1941, the company realized a profit margin of 6.48 percent on its cost-plus-fixed-fee contracts while on its fixed price agreements, a ratio of 17.38 percent was realized.

In any event, convincing proof is at hand which clearly shows that profit margins have reached their peak. The ratio of net profit to sales for representative companies is presented for the first half of 1940 and 1941.

	1st Half 1940	1st Half 1941
Curtiss-Wright	13.3%	7.5%
Douglas	13.4	7.9
Lockheed	10.5	7.0
Martin	21.3	10.8
North American	16.2	10.8
United Aircraft	15.9	4.6

With two years of war and fifteen months of the U. S. defense program completed, a number of vivid imprints have left their mark on the aviation industry. The astronomical expansion and accomplishments of the aircraft manufacturers are too well known to be repeated. Suffice it to say that two years ago, the aircraft industry was not

(*Turn to page 188*)

THE fighting spirit of Juan de Bermudez, pioneering sea-hawk and discoverer of the islands which today bear his name, sees action once again with the Brewster Bermuda, latest development of the famous Brewster Dive Bomber. With its combination of high speed, long range, and great striking power, the Brewster Bermuda will give new strength to the far flung defenses of Great Britain and the democracies.

Brewster

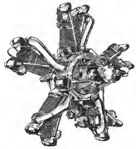
FIGHTERS and DIVE BOMBERS

FOR LASTING MASTERY OF THE AIR

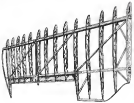
AEROQUIP HOSE LINES

AEROQUIP SELF-SEALING COUPLINGS

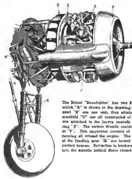
AVIATION SKETCH BOOK OF DESIGN DETAIL



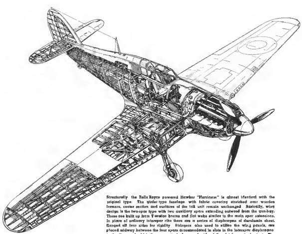
The latest Kinner R-53 Model is of standard design a five-cylinder unsupercharged radial developing 175 hp at 2100 r.p.m. Engine has a displacement of 540 cu. in and weighs about 358 lb. Compression ratio is 8 to 1. Advanced design features include completely enclosed full pressure lubrication system, greater bearing areas, more rugged master rod and improved valve gear enclosure.



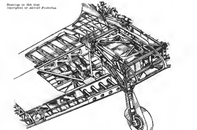
The wing of the Meyers OTW trainer is of two-spar construction The ribs are built up from a combination of wooden stringers and cross braces reinforced with plywood. The diagonal cross braces between the front and rear spars however are made of aluminum alloy tubing.



The Bristol "Beaufighter" has two Bristol Hercules III sleeve-valve engines one of which "A" is shown in the drawing. The collector ring and the front section of the cowl "B" are one unit, thus eliminating an extra piece. This and the exhaust manifold "C" are all constructed of riveted stainless steel sheets. The cowl flaps are attached to the louvre controls "D" which are controlled by a master control ring "E". The carbon dioxide container for the fire prevention apparatus is located at "F". This apparatus consists of a small metal tube perforated with holes and running all around the engine The two oleo pneumatic shock absorber main struts of the landing gear "G" are turned down from steel tubing and bolted to the supporting braces. Retraction is backward through the hydraulically operated strut "H" into the nacelle behind doors closed by elastic ropes.

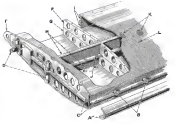


Structurally the Rolls Royce powered Hawker "Hurricane" is almost identical with the original type. The girder type fuselage with fabric covering stretched over wooden formers, cooler section and surfaces of the tail unit remain unchanged Basically, wing design is the two-spar type with two auxiliary spars extending outward from the gun-bay. These are built up from T-section booms and flat webs similar to the main spar extensions. In place of ordinary interspar ribs there are a series of diaphragms of duralumin sheet, flanged all four sides for rigidity Stringers also used to stiffen the wing panels, are placed midway between the four spars accommodated in slots in the interspar diaphragms to the flange of which they are attached on each side of the slot by a single rivet. The wing tip is a separate unit secured to the wing extension by a series of screws engaging nuts and is easily detached if damaged.



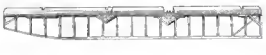
Outboard of the center wing section of the "Hurricane" nearly a third of the wing span is occupied by the gun-bay. In this portion, between the two main spars are mounted four Browning .303 guns. The two diagonal ribs, comprising T-section flanges and duralumin plate webs support the torsional stresses and carry the gun mountings At the roots and across the gun bay both main spars are box-type with T-section extruded booms and double webs of flat duralumin sheet riveted to the out side faces of the tongues on the extrusions. This box portion is stiffened internally by flanged sheet metal diaphragms riveted to both webs.

The Messerschmitt 110 horizontal stabilizer shown at right has been designed for quantity production and ease of assembly so that with other major components, it may be adapted to rapid manufacture under a reasonably accelerated schedule. Basic structure comprises symmetrical halves riveted together along mating flanges by brazier head rivets "C" around outside edge, with flanges of front beam "H" joined by bolts "J" inserted through holes pierced in skin sheets. These holes are later covered by cloth patches "K" doped in place. A cast magnesium nose section "A" is attached with flush screws at "B". The elevator hinges are at fitting "E", and the vertical fin attaching points are at "D". Skin is flush riveted "L" onto upper and lower ribs "F" "G". Rear beam at "I".

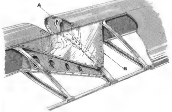


The fuselage of the Beechcraft D-17, at left, is built up of welded steel tubing. The complete fuselage frame is welded into one piece outside of the engine mount. This unit is attached by three through bolts, two at the top and one at the bottom center. Note the large diagonal brace extending from the center of the landing gear section to take a great part of the load.

The flap of the Beechcraft D-17, right, is of built-up plywood construction. Nose section is a curved piece of plywood and the ribs are built-up wood stringers. The trailing edge is aluminum alloy.



In the Messerschmitt 110 control surface nose section design, right, the box structure "B" carries torsion loads around the hinge cut out in which hinge fitting "A" is installed.



AVIATION'S SKETCH BOOK

Visual Teaching Methods

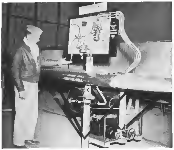
are used at the Dallas Aviation School

SEEING is believing for aviation mechanics who are trying to learn the business. A student who can see clearly how a wing flap operates, how hydraulic systems function, or who can study a cut-away engine, has gone a long way toward understanding them.

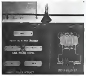
The Dallas Aviation School recently added a new division for the training of Air Corps mechanics. Joe Ben Lievre, Senior Instructor and in charge of the laboratory, has developed a number of teaching devices that will be of great help to students who will be servicing Army ships in a few more months. Those shown on this page are only a few of his designs.

In addition to these mechanical devices, the school's blackboards are filled with schematic drawings and diagrams in many-colored chalks. The testing device at the right, for example, shows how a gunner's belt has to withstand 250 lb. of weight and a pilot's 500 lb.

Testing gunners' and pilots' belts.

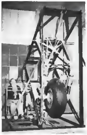


Mechanics servicing Army bombers must understand wing de-icer systems. This shows Mr. Lievre with a de-icing system for a single-engine plane. Pumps, valves and operation of rubber boot are visible and easy to understand.



Blackboards of classrooms are filled with schematic drawings and charts.

In the instrument shop students learn to calibrate instruments and then install them in panel boards. All instruction in the Army branch of the school closely follows the curriculum specified by the Air Corps.



Students learn how a hydraulic landing gear operates from this full-scale model.

Aviation RADIO

Dialing the Air Waves with Craig Walsh

Jefferson-Travis Portable Transmitter-Receiver

A portable transmitter-receiver (PTR-5) for aircraft, which may be licensed by manufacturers and distributors for temporary use aboard a number of different airplanes, is being manufactured by Jefferson-Travis Radio Manufacturing Corp., 374 Second Ave., New York. It has been designed especially for use on aircraft where permanent installation of radio equipment is impractical—for instance in the flyaway delivery of airplanes not equipped with radio at the factory.

The transmitter has a rated output of 5 watts, and tests indicate the actual power output is about 7½ watts. This power gives it a transmitting range of about 50 miles. The transmitter circuit uses three tubes: a 6J5 as a Pierce oscillator, a 6V6 modulator and a 6V6 power amplifier. Power for the transmitter is supplied by a motor-generator set driven by 6-volt dry batteries contained within the case. The transmitting frequency range is from 2000 to 6000 kc.

The receiver uses a tuned-radio-frequency circuit consisting of two r-f stages, a diode detector, an audio stage and a power output amplifier. The tubes used are two 6SK7's in the r-f stages, a 6SQ7 diode detector and first audio tube, and a 6V6 power output tube. The frequency range of the receiver is 200 to 400 kc. This is the band of the airport and radio range transmitters. High voltage for the plate circuits is supplied by MiniMax dry batteries and the filaments are powered by the dry batteries, which drive the motor-generator for the transmitter and supply filament power for the transmitting tubes.

Provisions are made to obtain power for the filaments directly from the plane's storage battery. If a 12-volt battery is used equivalent tubes in the 12-volt series are used. The PTR-5 transmitter-receiver is completely self-contained in a single case and for operation it is necessary only to connect it to an antenna. No installation work is required. The complete unit weighs 31 pounds and is enclosed in a two-tone grey fabric case.

New RCA Aircraft Transmitters

Two new aircraft transmitters by RCA Manufacturing Co., Camden, N. J., are intended to be basic units of a new line of coordinated aviation radio equipment. The two transmitters are similar except that one, the AVT-110, is powered by dry batteries and the other the AVT-111, is operated from a storage battery, either 6 or 12 volts. However, the design is so flexible that the AVT-110 can be switched over to storage battery operation with only minor changes. With either of these two units the purchaser can make additions from time to time to build up a complete, integrated radio communication system.

These two transmitters use permeability tuning, a new development in the field of light weight radio equipment for small airplanes. With this method of tuning, high efficiency and permanence of tuning adjustments are assured. The adjustments are quickly and easily made, but once made they cannot be affected by vibration, or extremes of temperature and humidity. Permeability tuning also gives reasonable assurance that flashovers in the tuning system will not occur at high altitudes, a safety factor in minimizing the danger of fire.

Communication with CAA or airport control stations is possible while in flight, landing or taking off, taxiing, or on the ground. Two transmitting frequencies are provided. At the turn of a switch the frequency can be changed from 3105 kc to 6210 kc, a feature usually found only on the more expensive equipment. An individual antenna coupling, adjusted at the factory, is used for each frequency to assure optimum results for long cross-county transmissions on the trailing wire antenna system.

A built-in loading coil loads the antenna to resonance when transmitting on the ground. The coil is continuously variable for exact tuning while landing or taxiing.

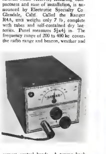
The tubes used are of the common, easily obtained types operated well within ratings to give long life. In life tests 1600 transmissions were made of approximately 30 seconds each (equal to about 14 hours) and the power output was still greater than 0.5 watt. Servicing of these units is made simpler by the installation of a meter jack for making routine adjustments. Also, the chassis can be removed through the front of the case.

Specifications of the RCA Aircraft Transmitters

	AVT 110	AVT 111
Transmitter Weight	4.2 lb	4.2 lb
Power Supply	Dry Battery Pack	Vibrator
Power Supply Weight	10.5 lb.	9 lb.
Transmitter Dimensions	Height 5⅜ in. Width 6½ in. Depth 4⅞ in.	5⅜ in. 6½ in. 4⅞ in.
Power Supply Dimensions	Height 6⅞ in. Width 6½ in. Depth 4⅞ in.	7 in. 5¾ in. 5½ in.
Power Rating	1.5 watt	6 watt
Modulation	100%	100%
Overall Distortion	Less than 15%	Less than 15%
Fidelity	Essentially from 300 to 3500 cycles	
Frequencies	3105, 6210 kc	3105, 6210 kc
Tubes	5 1Q5GT	4 6V6GT

New Ranger Unit

A new light weight, self-contained aircraft radio receiver, featuring compactness and ease of installation, is announced by Electronic Specialty Co., Glendale, Calif. Called the Ranger R4A, unit weighs only 7 lb., complete with tubes and self-contained dry batteries. Panel measures 5½x4½ in. The frequency range of 200 to 400 kc. covers the radio range and beacon, weather and



airport control bands. A tuning knob and combination "on"-"off" switch with rheostat are the only controls in the unit. Four new type RCA tubes are used. This receiver is a matching unit to the Ranger T5A transmitter of exactly the same size.

BUYER'S LOG BOOK

What's New in Accessories, Materials, Supplies, and Equipment

New line of a.c. transformer arc welders in 300, 500, 750 and 1000 ampere capacities has just been announced by *Wilson Welder and Metals Co., Inc.*, 60 E. 42nd St., New York, N. Y. Knowo as Model TW they are completely self-contained units for 220, 440 or 550 volts, 25 or 60 cycle current. Having a wide range of current output, continuous stepless current regulation is provided over entire range in the new welders by means of a hand crank atop of machine. This crank makes it possible to rapidly shift the setting as changes are made from one class of work to another. On 60 cycle units, all sizes are fan cooled except 300 amp. size, which is cooled by natural draft. These units have high and low range switches. On 25 cycle units, having only one range, all sizes are fan cooled. Model TW conforms to N.E.M.A. requirements.—AVIATION, *October, 1941*.

Featuring lighter weight, combined with proper speed to perform the driving of 5/32 in. dual rivets in the assembly riveting of lighter types of aircraft, the new 3Z Thor Extra-Light Pneumatic Riveting Hammer is announced by *Independent Pneumatic Tool Co.*, 600 W. Jackson Blvd., Chicago, Ill. A "slow-hitting" type of hammer, leakage and loss of power is impossible because the air does not wipe across the large surfaces of the sleeve type valve, thus resulting in highly efficient operation. No. 3Z Riveting Hammer is available in five handle styles having $\frac{5}{8}$ in. bore and 3 in. stroke suitable for $\frac{3}{16}$ in. soft iron and 3/16 in. aluminum rivets.—AVIATION, *October, 1941*.

Two greatly improved series of 4 and 6 hp. portable spray painting air compressing outfits, for operation of two or three spray guns, have just been released by *DeVilbiss Co.*, 300 Phillips Ave., Toledo, Ohio. All 6 hp. units have twin disc clutch as standard equipment, permitting starting of engine independently of the compressor, and may be had with or without an electric starter. Air or water-cooled engines are optional with this series. Twenty assemblies are included in the two series—skid-mounted outfits, rubber-tired and steel wheeled trucks, and two wheeled trailers.—AVIATION, *October, 1941*.

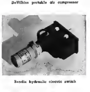
Improved ventilation in aircraft cabins may be obtained by installation of Snap Vent Aircraft Cabin Ventilators developed recently by *Burton B. Simcox*, 521 W. Cumberland Ave., Knoxville, Tenn., and distributed by leading aviation supply houses. Snap-Vent Ventilators are of lightweight, one-piece construction made of molded transparent plastic. Either the intake of fresh air or the exhaust of cabin air may be obtained by rotating the setting of the ventilator. Quick installation may be made in ten minutes on private airplanes by means of a device furnished to cut out the installation hole, and when installed their resilient construction prevents their vibrating from a set location. By their use draft and noise from open windows is eliminated.—AVIATION, *October, 1941*.

Operation of warning lights to indicate changes of pressure in hydraulic lines, or automatic starting or stopping of motor-pump combinations, are among the uses which can be made of the new high pressure Hydraulic Electric Switch developed by *Bendix Aviation, Ltd.*, Burbank, Calif. Of small overall dimensions and weighing little more than half a pound, the unit contains a highly sensitive electric switch actuated by hydraulic pressure.—AVIATION, *October, 1941*.

Exceptional balance for precision work, light weight of only 7 oz., convenient front end valve wheels for one-hand flame adjustment, compactness to get around jigs and fixtures, and a fast penetrating flame for sound, uniform welds are said to be found in the new Rego Aircraft Welding Torch made by *National Cylinder Gas Co.*, 207 W. Wacker Drive, Chicago, Ill. Flame characteristics may be varied from short to long pointed, as each tip covers a relatively wide range of heat output. Long bend and short bend swaged tips of pure copper, with brass protectors to prevent damage to tip threads, are available in sizes 76, 72, 68, 62, 59, 55, 53 and 51 (drill size of orifice).—AVIATION, *October, 1941*.

Wilson a.c. transformer arc welder

DeVilbiss portable air compressor



Bendix hydraulic electric switch

Nat'l Cyl. Rego Welding Torch

Actus Prod. aviation clamp

An extremely strong aviation clamp is announced by *Actus Products Corp.* Mt Vernon, N Y, which is claimed to be the strongest one-size clamp made. Consisting of a continuous strap of stainless steel 12 in. long, it is said to have positive metal to metal lock, a tensile strength of over 40,000 lb, and to be unaffected by vibration. Clamp fits from ½ to 3½ in hose and can be installed after assembly in any position, any angle, with 100 percent surface contact.—AVIATION, *October, 1941*.

Detroit Universal "Dudco" pump

Metal Shielded Wire, a development which should be of particular importance in the electronic and radio equipment fields of aviation, is manufactured by *Precision Tube Co.*, 3824 Terrace St, Philadelphia, Pa. New product consists of shielding any type of insulated wire with either seamless aluminum or copper tubing, tinned or untinned. This affords maximum protection against moisture, corrosion, alkalies, mechanical damage and fire hazards. Compact, light in weight, easily bent to the shortest radius, the new Shielded Wire may be stripped quickly, cleanly and easily. It is available in lengths up to 50 ft and may be had in sizes from a single conductor (.018 in dia.) to multi-cable types of one inch outside diameter.—AVIATION, *October, 1941*.

"Virtually breakproof," a new variable delivery hydraulic pump of dual vane design is announced by *Detroit Universal Duplicator Co.*, 253 St. Aubin, Detroit, Mich. Designed for continuous operation at 1250 lb. p.s.i., the new "Dudco" pump is recommended for use where possibility of line surges requires a "breakproof" pump. The Dudco can also be used where periodic pressures go as high as 2000 lb. p.s.i. Rate of delivery is controlled by means of an adjustment screw and can be done while pump is operating. Dual vanes are employed, each vane bevelled around its entire edge so that oil from oil hole in rotor can flow around all edges of the dual vanes. Vanes, rotor and stator halves are of hardened and ground steel, as is the splined drive shaft. Available in range of from 8 to 0 gal. per min.—AVIATION, *October, 1941*.

Harris Products tube fitting

Low cost tube fittings having high pressure capacity rating, which reduce sound transmission in lines and permit rapid assembly without special tools for the lower capacity uses, are brought out in a new line by *Harris Products Co.*, 5407 Commonwealth Ave., Detroit, Mich. New fittings, known as "Sealflex" will handle high pressures while permitting vibratory flexing up to 10 deg. included angle and may be used for air, gas, gasoline, etc. Tubing is prevented from slipping by a metal ferrule which is "rolled in" on it, so that connection does not depend on the shear strength of the rubber or synthetic. No flaring of tube is necessary for the lower angle of flexibility, thereby eliminating possibility of splitting tube at flare permitting leakage.—AVIATION, *October, 1941*.

Kollsman altitude indicator

For the safe clearance of high mountains, one of the most important considerations for a pilot is the effect of temperature variations in the air column on the altimeter reading. *Kollsman Instrument Div.*, Square D Co., Elmhurst, N. Y., has brought out a handy Altitude-Temperature Relationship Indicator which obtains the true altitude in a simple operation. Just pull out the tab on the Indicator until the outside temperature reading is opposite the indicated altitude of the instrument. Then read below the true altitude opposite the indicated altitude.—AVIATION, *October, 1941*.

A new process, whereby *Republic Engineering Products, Inc.*, 480 Lexington Ave., New York, N. Y., is able to supply sensitized materials such as steel plate, brass, copper, and various steel alloys as well as plywood and plastics for making photographic copies of all kinds, is now available. Some of these materials may be secured in any commercial thickness, such as ⅛ or ½ in. cold-rolled steel, the type used for making templates. Drawing is photographed directly on the sensitized surface and then developed.—AVIATION, *October, 1941*.

For safe, economical cleaning of aluminum and aluminum alloys before anodizing and painting, Kelite K.D.L. #1 is said to be the most satisfactory and rapid cleaner for the multitude of parts made in aircraft plants. Developed by *Kelite Products Inc.*, 87 Frankfort St., New York, N. Y., this product when used in concentrations varying from 2 to 4 oz. per gal., at temperatures ranging from 140 to 212 deg. F will do a thorough job of cleaning aluminum surfaces without affecting them in any way. Even when a concentration of 1 lb. per gal. at boiling temperature is used no effect is said to show on aluminum and the metal loses no weight.—AVIATION, *October, 1941*.

Cambridge Fabric Permeameter

Production testing of the permeability of doped airplane fabrics and fabrics to be inflated with hydrogen, helium, carbon dioxide, etc, may be carried out with a new instrument, the Fabric Permeameter, made by *Cambridge Instrument Co, Inc*, New York, N. Y. Lateral diffusion as well as leakage at seams can be determined. Test sample is clamped between two recessed test plates. Hydrogen is passed into lower compartment, upper filled with clean air communicating with metering unit. Gas permeating fabric contaminates the air, changing its thermal conductivity. Metering unit in Test Plate assembly connects through control box to portable spot galvanometer, calibrated to read directly in hydrogen leakage in liters per sq. meter per 24 hrs.—AVIATION, *October, 1941*.

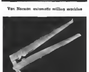
An automatic bed-type milling machine with hydraulic table feed for high production milling of small and medium parts has been brought out by *Van Norman Machine Tool Co*, Springfield, Mass. Machine, Model No. 118, incorporates such features as automatic table cycle, automatic spindle stop, rigid construction and ease of operation. The spindle transmission is driven by 3 hp. motor, hinge-mounted to facilitate belt adjustment to main drive pulley. Spindle speed changes are obtained through pick-off gears. Working surface of table, 34x10 in.; table feed range ½ in. to 40 in. per min. Rapid traverse, 200 in. per min. Machine occupies 64x46 in. floor space.—AVIATION, *October, 1941*.

The **"Handy Knurler"**, a new type knurling tool which is held by hand like a pair of pliers and uses three knurls, is just being introduced by *Pacific Tool & Supply Co*, Los Angeles, Calif. It can be used on work held in a lathe chuck as well as in a drill press and even in a vise, and will knurl diameters from as small as ⅛ in. up to 2 in. All that is necessary is to bring the knurls in contact with the work and to compress the handles.—AVIATION, *October, 1941*.

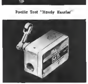
A splash proof, malleable housed precision switch which can be mounted from any one of four sides for use as an interlock, limit, or pushbutton switch is announced by *Micro Switch Corp*, Freeport, Ill. Two tapped holes for No. 10-32 screws are on each of four sides, making it possible to mount switch to a machine from practically any position. If lug or foot mounting is desired, 3/16 in. thick steel mounting plates can be had. Switching element is a Bakelite Micro Switch providing precision operation, ample overtravel and long life, listed at 1200 w. up to 600 v. a.c. Roller arm types are of aluminum, adjustable through 360 deg. with a roller of non-sparking material of high concentricity. Overtravel on this switch is 90 deg.—AVIATION, *October, 1941*.

High-low-High condenser discharge spot welders for aircraft assembly work are said to be producing unexcelled high test welds in widely used gages of aluminum alloys not only at high production speeds but at low condenser values. The special cam and air pressure device used on the Thomson Condenser Discharge Welders, made by *Thomson-Gibb Electric Welding Co*, Lynn, Mass., automatically provides for a High-low-High pressure cycle. The cam is arranged so that the electrodes do not hammer. As soon as contact is established, a pair of air cylinders working in tandem act on the electrodes to provide the initial high pressure. Directly following this "contacting" pressure, the special cam allows follower roller to dip into a valley, leaving only the low inertia, air-lock cylinder effective to provide welding pressure while current is being applied. Immediately following current flow, the cam puts second air-lock cylinder into action to supply necessary reforging pressure. No air valves are used in securing pressure sequence and no air is admitted or released from circuit during the cycle, thus sequence follows in correct order.—AVIATION, *October, 1941*.

Van Norman automatic milling machine



Pacific Tool "Handy Knurler"



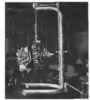
Splash proof Micro Switch

Thomson High-low-High spot welders


Gorton Munitions Engraver

A new simplified Munitions Engraving Machine, which can be operated by unskilled workers, has been developed by *George Gorton Machine Co.*, Racine, Wis. This engraver reproduces, in reduced size, from large masters or models of the work whether it be for engraving dials, profiling small shapes or light milling on intricate parts.—Aviation, *October, 1941*.

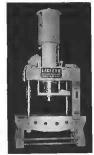
Good, clear blue prints are said to be made from pencil tracings on a new white tracing cloth, called Whitex, produced by *Frederick Post Co.*, Chicago, Ill. Every pencil mark is said to be dense and sharp on Post's No. 123 Whitex which is tough, durable and will not discolor with age. Its glossy "stay clean" back is an added feature and its extra transparency adds speed to print production. Whitex also erases quickly and cleanly with art gum and erasures do not show on the blueprint. All in all, the new tracing cloth is said to enable draftsmen to produce in fine detail and at pencil speed, ink quality, contrasty blueprints.—Aviation, *October, 1941*.


Whiting portable engine hoist

A new portable engine hoist is announced by *Whiting Corp.*, Chicago, Ill. Design eliminates all superstructure with exception of a single upright, equipped with riser steps and adjustable platform. A chain hoist raises and lowers engine or supports it at any desired height. Unit, which is easily moved and may be locked in position, is available in any desired height.—Aviation, *October, 1941*.

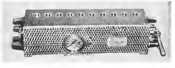
Combining the advantages of $\frac{1}{8}$ in. over-travel, large reduction in effective operating pressure, and construction suited to high speed cam operation, a new Type Y Actuator has been brought out by *Mu-Switch Corp.*, Canton, Mass. The new actuator comprises a nickled steel arm carrying at one end a graphite impregnated, self-lubricating bakelite roller and pivoted on an oil-less bearing at the other end. A "U" spring of phosphor bronze, riveted to the under side of the arm, transmits actuating force to the operating button of the switch and absorbs excess movement at the roller. Design of the attachment bracket permits Type Y Actuator to be applied with equal facility to either side of standard Type M (a.c.) Mu-Switch and heavy duty Type D (d.c.).—Aviation, *October, 1941*.

A 100 ton hydraulic press for straightening light armor plate is announced by *Lake Erie Engineering Corp.*, Buffalo, N. Y. The press is selfcontained with pumping unit mounted on top. Working space is accessible from all sides for speed and convenience in handling the material and correct spacing of supporting blocks, on working surface of bed. This type of press, with its control of pressure, provides the ideal means of straightening plate which has become distorted or warped by heat treatment.—Aviation, *October, 1941*.



Lake Erie hydraulic press

Gang milling operations on small parts are being speeded in a number of aircraft plants by use of new Hydra-Grip work holders introduced by *Hydra, Inc.*, Los Angeles, Calif. Hydra-Grip is a work holder operated hydraulically which holds up to ten pieces accurately for precision machining on milling machines, shapers, grinders or drill presses. Work is dropped into the collets and a few strokes on the pump handle brings gripping pressure at all points up to 5000 lb./sq. in. Collets are available for a full range of sizes from $\frac{1}{2}$ to $1\frac{1}{2}$ in., to hold round, square or hexagonal stock, with special shapes and sizes available on order. Hydra-Grip attachment measures 29 in. by $5\frac{1}{2}$ in. wide, by 6 in. high, and weighs 125 lb.—Aviation, *October, 1941*.


Hydra-Grip work holder by Hydra

BLAINE STUBBLEFIELD Washington | C. F. McReynolds Pacific Coast | Randolph Hawthorne New York | E. R. Leckin New York | OCTOBER 1941

Pan American Plans New York-Africa Service Will Ferry U. S. Planes to British East Front

Washington (AVIATION Bureau)—Pan American Airways' projected commercial and ferry service to Africa takes the system two thirds of the way around the world. It is anticipated that PAA may, before the war ends, close the gap between Leopoldville, Belgian Congo, and Hong Kong, China, a distance of about 8 100 miles. The African operation is a result of, and a service for, the Anglo-American war effort, but there is small doubt it will continue and expand after the war. Pan American now becomes more than ever a quasi-governmental agency, involved in international relations, in strategic commerce, and on the margin of actual combat.

The African transport extension, and the ferry service, are both regarded as projects of the Washington administration. Just what the Army may have thought of this diversion from its own Ferry Command, of course was not publicly stated. On the night before CAB was to hold a hearing on PAA's application for certificates, the War Department, without stating reasons, asked for a postponement.

Several of the airlines filed interventions immediately. Among these was American Export Airlines, whose efforts to get in the U S foreign air service have been opposed by Pan American. Observers recalled that only a few months ago Congress refused money for Export mail contracts. Now the Administration's rush for more service may cause Export's friends to demand reconsideration of its plans to get on the Atlantic.

Inconsistency in the picture is that the Administration—War, Navy, State, Commerce, Post Office Departments, fought Congress' rejection of Export's mail appropriation. It was said at the time that the Pan American lobby beat the Administration itself. Meanwhile, Export is going ahead with Sikorsky flying boats and a hangar at LaGuardia Field, and speculation is that company might start operations without a mail contract. A New York-Lisbon certificate already has been granted Export by CAB.

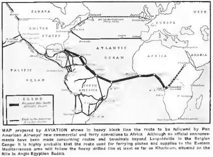
But any objections, in the face of the President, who announced the plan right after his talk with Churchill at sea, were destined to be over-ridden, for the Pan American-African service is in fact a major step in the Lend-Lease program.

This is the Pan American plan, subject to probable change as the war goes on: (1) to operate a regular transport service, mail, cargo, and passengers, from New York to Leopoldville, inland in the Belgian Congo, and more than half way down the West Coast of Africa, (2) extend the transport service

(Turn to page 129)

Press Association

EDDIE ALLEN flies the newest version of the Flying Fortress, the B-17-E, completed last month in Seattle. This edition is longer, roomier in the tail, faster and has more fire power than previous models. Ship has more efficient turrets on both top and bottom, as well as a vicious tail gun. The wind-catching bathtub on the belly is gone. Engines are larger. An even later version of this powerful bomber, the F model, will be built in the Boeing-Vega-Douglas coordinated program. Meantime, this ship is in production at Boeing and the British are eager to receive their share for night bombing this winter.



MAP prepared by AVIATION shows in heavy black line the route to be followed by Pan American Airways' new commercial and ferry operations to Africa. Although no official announcements have been made concerning routes and terminals beyond Leopoldville in the Belgian Congo, it is highly probable that the route used for ferrying planes and supplies to the Eastern Mediterranean area will follow the heavy dotted line at least as far as Khartoum, situated on the Nile in Anglo Egyptian Sudan.

CAA Reports Expansion Of Civil Airways

Washington, (AVIATION Bureau)—Reporting on the status of the United States Civil Airways as of September 1, 1941, Civil Aeronautics Administrator Donald H. Connolly said that, despite difficulties imposed in some cases by shortages of labor and supplies, expansion of the Federal Airways System continued during the past twelve months.

The lighted, operating airways increased by 2,169 miles, making a total of 30,913; 7,945 additional miles are under construction and 921 are under survey. There are now 2,276 airway beacons as against 2,207 one year ago. Intermediate landing fields increased from 295 to 310.

The teletype system, over which instructions and information for the orderly direction of airways traffic are transmitted, increased from 11,880 to 13,292 miles, and the weather recording stations with a teletype mileage of 27,068 last year now total 29,422. An additional national teletype network of 24,269 miles is nearing completion.

An important part of the airways expansion program was the construction of 26 additional radio range and communication stations. Of these new facilities, 15 are in operation and the others are being commissioned as soon as radio equipment is available. With these additions, there are now 114 full power, 139 medium power, 33 low power radio range and communication stations in operation.

A. M. Rochlen

Aviation News Committee Reports Year's Progress

On the occasion of the first anniversary of the formation of the ACCA Aviation News Committee, its chairman, A. M. Rochlen of the Douglas Aircraft Company, submitted a report outlining the activities and achievements of the group since August, 1940. Rochlen, along with Lauren D. Lyman and Howard Mingos, vice chairmen and secretary of the Committee, respectively, conceived of the idea of establishing a coordinated information source for the dissemination of reliable facts regarding the defense efforts of the aviation industry.

The high measure of service rendered to the public and the industry is attested by the widespread response and cooperation of magazines, newspapers, radio and other information channels. Principal media of the program have been Aviation News Features, issued twice monthly, and the Aircraft Record, a manual of defense data and statistical charts.

Press Association

THREE MEMBERS of the Russian group that flew to the U. S. L. to r: Col A. B. Umashev, Anton M. Vedotov, Gen M. Gromov.

Five in Collier Race

The Collier Trophy Committee, at a recent meeting at NAA headquarters, eliminated all but five of 18 nominations for the annual award.

Still in the running are: Dr. Sanford A. Moss, "father" of the airplane supercharger and turbosupercharger, which give sea level performance to planes high up; the Bendix Aviation Corp., for development of the Stromberg Injection Carburetor; Asst. Secretary of Commerce Robert H. Hinckley, for the expansion and safety record of the Civilian Pilot Training program; W. T. Piper, for development of the light plane; and Fred Weick, for development of the two-control airplane—non-spinning and stable. Final choice will be announced in the early fall.

Newark Air Carnival

An Air Carnival was held at Newark Airport September 14, celebrating the opening of the new $250,000 administration building to commercial airlines. The Carnival was managed by Steadham Acker, director of the Annual National Air Carnival at Birmingham and the Denver Air Show. Proceeds went to the Royal Air Force Benevolent Fund and the American Eagle Squadron of the RAF.

CAA Controls Traffic At 39 Airports

By mutual agreement with the Army and local authorities, the CAA will assume jurisdiction over air traffic control at 39 airports where military and civil aviation operations are causing serious congestion.

An allocation of $1,000,000 of Army funds has been turned over to CAA to expand control tower facilities at these fields and to train crews of control tower operators. On January 1, the locally-employed personnel will be transferred to CAA's payroll where, joined by the CAA-instructed employes, they will work with the aid of Army advisers to simplify flight movements in and out of the crowded airports.

This first list of 38 fields is expected to be lengthened as military flying activities increase in other localities.

Officials explain that local traffic control has been satisfactory but that it was decided improper for local authorities to exercise jurisdiction over military aviation.

Meanwhile, Rep. Jack Nichols is moving ahead with plans to seek Congressional approval of his bill which would extend CAA control permanently from "ramp to ramp" on Federal airways.

2 Ferry Command Bases

Two new air bases at Presque Isle and Houlton, Maine, for use by the Air Corps Ferrying Command, have been authorized.

Construction at Presque Isle is estimated at approximately $3,000,000; for Houlton about $2,418,000.

Personnel at both bases will include some British ferry crews. At Houlton there will be about 229 officers and 486 enlisted men.

Taylorcraft Record

J. Merrill Kayser of Lubbock, in a Taylorcraft Trainer, on August 12, set a record from Alliance, Ohio to Lubbock, Texas, a distance of 1,275 miles. His average speed was 98 miles per hour. Seven stops for refueling, averaging 10 minutes each, were made. This ship powered with a 65 hp. Franklin engine, was a flyaway delivery for the Wm. Clent Breedlove Aerial Service, Taylorcraft distributors, at Lubbock.

War Znoe Restrictions Bother the Air Lines

Expansion of the Army's list of "restricted areas", over which non-military aircraft may not fly, is creating something of a problem for the airlines.

Already one airline has three trouble spots which must be bypassed under the defense regulations.

CAB, War and Navy officials are studying the question in the hope of avoiding undue delays in scheduled air transport operations, and at the same time assuring adequate protection of munitions plants, service bases and other strategic areas.

Violations of Regulations

Violations of Civil Air Regulations are declining in spite of the tremendous increase in flying, according to the CAA report of offenses over the past year.

Of the 1,575 pilots who violated regulations last year, 1,014 were new flyers while only 48 were airline pilots.

"Acrobatics" was the chief offense, accounting for 230 violations, while "pilot laziness" in not disconnecting dual controls came next with 128 infractions. 102 private flyers used the civil airways without certificate and 120 students took their friends on unauthorized flights.

One hundred sixty-six pilots flew below minimum altitudes, while 9 flew over "restricted zones", eliciting a special stern warning from the CAA. Other violations were generally less numerous.

During the year, CAA collected $10,725 in fines, all paid voluntarily except $1,750 which had to be squeezed out in court proceedings by the Justice Department.

Only 77 licenses had to be revoked, 33 suspended.

NAA Membership Drive

The National Aeronautic Association is launching a vigorous membership drive during the fall season, including a campaign to increase the number of local aero clubs.

At the same time, the national headquarters is spurring its chapters to more active participation in defense and civil aviation programs.

Specific projects suggested include aid in recruiting flying cadets, cooperation in training programs, stimulation of public support for airports, hangars, airway aids and training.

NAA officials report that during the usually dull summer period, the growth and activity of the association continued at almost as high a rate as in the spring months.

Research on Ice

Bureau of Standards, Department of Commerce, is making an investigation, sponsored by the Army, Navy, NACA, and the CAA, of means to prevent the icing of the intake systems of aircraft engines. Ice forms inside and at times clogs different parts of the intake system, which, under extreme conditions cuts off the supply of air and even the flow of gasoline. When a pilot is aware of icing before it becomes dangerous he can usually dissipate the ice by hot air or alcohol.

Photographs of tests already made show icing in the intake system which looks like the inside of an over-frosted refrigerator. The icing problem has received serious engineering attention, but in spite of progress, a dependable solution remains to be found.

NACA has a committee working on means of de-icing the wings and propeller. The most promising one seems exhaust heat for the wings.

SPOT CHECKING

Pan American-Grace starts air mail service on West Coast of South America—another important step toward axing the Axis out of that continent. PAA will continue regular winter flights to Alaska. 150 employees of the company are studying Portuguese.

Defense travel on air lines is now as high as 81 percent of the total, according to Transport Association survey. Two thirds of travel applicants turned away are on defense business.

Maj Gen. Geo H. Brett, chief of Air Corps, and party of officers, are touring the principal battle zones, to get first-hand picture of British needs.

Four Bomber Commands are created within the Air Force Combat Command, thus completing the organization of the AFCC, which is the striking arm of the Army Air Forces.

A priority rating of A 3, considerably higher than that granted to any other form of transportation, has been given to the airlines to aid them in meeting repair and maintenance needs. Road, rail, and water transport get A-10 rate. Airlines and suppliers of maintenance equipment and parts, upon applying to OPM for the rating, may attach it to orders for all materials entering into upkeep of planes and ground equipment.

The Lockheed P-38 Interceptor is "the fastest airplane in the world today", says Robert A. Lovett, Assistant Secretary of War for Air—well over 400 mph with full military load. It has two engines, carries 37 mm cannons and 50 caliber machine guns.

XPB2M-1. Martin's new 70-ton flying boat, probably the world's biggest airplane, was viewed by news men for first time Sept. 11. It lacks about three-quarters completed.

K-3, first large blimp for coast patrol by Navy, is being tested, 48 of them are on order. The blimp Enterprise, which has flown tourists over Washington for years, is now training pilots for Naval reserve.

A new credit card has been adopted by 17 airlines. It was developed by American Airlines with Farrington Mfg. Co. It is an adaptation of the "addressograph" plate.

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

Priority on "How to Win Friends"

The British want us to switch some of our pursuit plane building capacity over to bombers. This would leave us without the capacity to produce the fighting planes we might need if we fight, and the Army doesn't like it. However, the Russians want us to build fighters for them, which would please our Army. The outcome depends on the talking ability of Winston Churchill and Joe Stalin, with General Brett in the middle.

A bomber manufacturer got from Washington an impressive document authorizing him to attach a priority rating to everything he ordered for building aircraft. So he attached it to an order for six copies of a book "How to Win Friends and Influence People."

The Stubblefield Award goes to OPM for telling everybody to substitute plastics for scarce strategic metals, and then putting plastics under priorities because they were scarce, too.

Flying to Africa and the Near East by Pan American Airways is the actual equivalent of an aerial occupation of Dakar by the United States. Hundreds of pilots will learn that country like a book of relief maps. In a broad sense, the Pan American enterprise adds a strong air auxiliary to the Navy in its job of blocking the narrows between Africa and Brazil, the Nazi gateway to this hemisphere.

Just to show you how some airplane statistics are made, a bright young man we know, an aviation writer, set down and made a rough guesstimate of current production of war planes by all the major powers. His guesses were published frankly as such in a trade magazine. One of the big press services picked them up from an "authoritative source," and the newspapers used them. The last our young man *saw* of his figures, a semi-official British aviation report quoted them from a *British* newspaper, which quoted the original trade magazine. Then he *heard* them—on the radio.

Six Transatlantic services will be in operation, with Pan American's New York-Congo line established. Reading from North to South, you have: Atferro, the British Ferry command, from New Foundland to Ireland; Pan American, from New York to Lisbon; British Overseas, from Baltimore to England; Pan American from New York and/or Baltimore to the Congo via South America; Army's transport line, Washington to England; and the Italian LATI line from Rome to Natal, Brazil. If American Export starts operation (without an airmail contract, as matters stand) that would make seven. The German lighter-than-air line to Latin America suspended when the war started.

They say in Washington that Howard Hughes is working out some super-secret development at his factory near Los Angeles. There is a police guard at the door, and not a soul will talk about it. There is a two-mile runway near at hand, for whatever you want to make of it. Considering Hughes' reputation, most people assume his project is important.

Restricted zones are causing the airlines more and more trouble—flying around them, so foreign agents riding as passengers can't make notes and pictures. The list of zones may be withheld from publication, as such information would tell the spies where the important bases are.

CALLING NAMES

Shreve M. Archer, president of Archer-Daniels Midland Co., is re-elected chairman of the board of Northwest Airlines.

Walter B. Biggs, chairman of War Department's National Technological Civil Protection Committee, is in England to investigate technical aspects of civil protection.

Commander Edward O. McDonnell, USNR, relieves **Commander Donald F. Smith** as commanding officer of Naval Air Station Floyd Bennett Field.

Howard B. Baxter, chief of United Air Lines meteorology department, is appointed superintendent of technical instruction at Boeing School succeeding the late **Hubert Marsh**.

S. A. Harris succeeds **W. F. Newbery** as eastern regional manager of Detroit Rex Products. Newbery is promoted to Detroit office.

Charles E. Wangeman heads the Bureau of Placements at Carnegie Institute of Technology, replacing **John B. Beatty**, resigned.

Florence Boller, pilot and **Albert B. Lary**, Stinson Flying Corp executive, wed.

Martha Collac, Braniff hostess and **Byron W. Ogle**, Braniff district traffic manager at Amarillo also take vows.

Lt. Ervin D. Shaw, killed in action in France in 1918 honored by naming of Air Corps field at Sumter S. C. "Shaw Field".

Milton W. Lightcap becomes sales manager of newly created Painter & Maintenance Division of Devoe & Raynolds.

George G. Raymond continues as president of Lyon-Raymond Corp., new name of former Lyon Iron Works of Greene, N. Y.

John L. Foley is distributor for Hobart Brothers in the Buffalo territory.

Oscar Bergstrom advances from district traffic manager to newly created post of assistant general traffic manager for Delta Air Lines.

Stanley Webber is named director of public relations for Delta Air Lines; had held same office for Ingersoll-Rand in U. S. and Mexico.

Harold Montee is transferred to the New York home office of Aero Insurance Underwriters and **Jean H. DuBuque** succeeds him as manager of the Chicago office.

Pvt. Robert Reid Stubbs of the Air Corps turns over to War Department his invention of a new type of bomb dispersal device.

Henry Butler, sales representative for American Airlines in Dallas is appointed city sales manager at Memphis; **Hal Hixon** succeeds him.

Squadron Leader Eric Roe of the R.A.F., son of **Sir Alliott Verdon Roe** of A. V. Roe Co., is reported missing.

Dr. Edward E. Minor, Jr., research and development engineer of Glenn L. Martin Co., is reappointed chairman of the Committee on Air Transportation of American Institute of Electrical Engineers.

Evert C. Bokanen is appointed manager of new Los Angeles office of Whiting Corp., Aviation Department.

F. D. Munschauer is elected president of Niagara Machine & Tool Works, and **George B. Kinney** succeeds him as vice-president.

Maj. Gen. Davenport Johnson is assigned to duty with the Caribbean Defense Command, succeeding **Maj. Gen. Frank M. Andrews**, recently designated head of the Caribbean Defense Command.

ALLISON ENGINES, more powerful than earlier models, are crowding each other off the lines at General Motors' Indianapolis plant. They go to Curtiss, Bell, Lockheed and North American.

EDWARD G. BERN, American Airlines' National Director of Publicity, receives a five-year pin from C. R. Smith, president. Ed has been in the aviation business 22 years.

Maj. Gen. George H. Brett, Col. Ray A. Dunn, Col. James B. Newman, Jr., Lt. Jack W. Perry, and **Harry C. Short** are on an aerial tour of Africa, Near East, Mediterranean and Atlantic war fronts to promote development and procurement of aircraft and equipment. **Lt. Col. E. M. Powers, Maj. James H. Doolittle**, and **Lt. Col. H. B. Boyd** are on a similar tour and will meet Gen. Brett's party at certain points.

Prof. Philip Jessup of New York is named an official of the Order of the Southern Cross, Brazil's highest decoration, for heroism in the crash of a Panair do Brasil air liner on Aug 18.

James L. Goddard is manager of Plomb Tool Co.'s new industrial relations department.

D. B. Baxter is appointed general superintendent of Copperweld Steel's Warren, O. plant.

S. Wallace Murkland is elected a director of Western Electric and succeeds **Richard H. Gregory**, retired as comptroller. **Stanley Bracken** engineer of manufacture and president of Teletype Corp., a subsidiary, is also elected a director.

E. V. Blake, eastern manager of Belden Manufacturing, is named Defense Coordinator and **J. V. Van Buskirk**, formerly in the sales department, heads the Priorities Division of the company.

Capt. Alan E. Burdin, former RAF pilot, is chairman of a flying ambulance campaign through the Bundles to Aid British Division of the British American Ambulance Corps.

Arthur S. Hanford, founder of Tri-State Airlines and board chairman of Mid-Continent Air Lines, recently passed away.

Donald N. McDonnell is elected to the directorate of Vultee Aircraft.

Edward H. Butler is elected to the directorate of American Airlines.

T. B. Wilson is chairman of the board of directors of TWA.

B. F. George, formerly supt. of flight operations, becomes operations mgr with jurisdiction over the Trans-Canada system. **H. H. Beaupre** and **F. M. McGregor** are appointed operations supts.

1st Lt. Laird W. Hendricks, Air Corps, assigned as an observer in London, England was killed in an airplane crash in England July 28 1941. He was flying as American plane out in the combat zone.

James H. Cobb, Jr., is appointed director of publicity of Delta Air Lines.

Lt. George E. Meeks, 27, Army flier killed in a plane crash on August 19 was the first American fatality in this country's military defense occupation of Iceland.

George E. Boddaway, editor of the magazine Southern Flight, publishes a bluebook of approved aviation schools in the United States.

Harry E. Karst goes to Denver as Western Air Lines' representative for the Rocky Mountain area and **Roy B. Thompson** to San Diego as district traffic manager.

Clarence B. Scott becomes sales manager of the Air Conditioning Division of Fedders Manufacturing Co.

Bernt Balchen is assigned as Captain Specialist Reserve in the Air War Plans Division of the Army Air Forces, Washington.

Howard L. Mingos, v.p. of the Aero Chamber, receives the Aviation Writers Association Award of Merit for services to the industry in the field of press relations and public education.

B. T. Larson succeeds **B. B. Colyer**, resigned as vice president of Trans-Canada Air Lines.

Thomas G. Early is appointed executive assistant to Col. Donovan, Coordinator of Information, and **Darwin C. Brown** succeeds him as secretary of CAB.

Paul M. Hollard leaves Sanderson & Porter to become secretary-treasurer of Adel Precision Products Corp.

Brig. Gen. Frank P. Lahm, credited with being first officer to qualify as balloon and airplane pilot, is nominated to rank of Major General. He is now First Army air officer at Governors Island, N. Y.

Name of Stearman Aircraft Div. of Boeing Airplane Co. is changed to **Wichita Division, Boeing Airplane Co.** Operations and management remain unchanged.

Coming Events

Oct. 1–Nov. 7 Aeronautical Exhibition, Winged America, Maryland Academy of Sciences, Baltimore, Md.
Oct. 2–4 National Association of State Aviation Officials, Annual Convention, Providence, R. I.
Oct. 6 Air Line Mechanics Association, Annual Convention, Chicago, Ill.
Oct. 6–8 28th National Foreign Trade Convention, Hotel Pennsylvania, New York, N. Y.
Oct. 6–9 National Safety Congress, Stevens Hotel, Chicago, Ill.
Oct. 6–11 Exposition of Power and Mechanical Engineering, International Amphitheater, Chicago, Ill.
Oct. 12–15 American Society of Mechanical Engineers, Fall Meeting, Louisville, Ky.
Oct. 20–24 23rd National Metal Congress and Exposition, Convention Hall and Commercial Museum, Philadelphia, Pa.
Oct. 23–24 SAE National Fuels & Lubricants Meeting, Mayo Hotel, Tulsa, Oklahoma.
Oct. 30–Nov. 1 SAE National Aircraft Production Meeting (and Engineering Display), Biltmore Hotel, Los Angeles, Calif.
Oct. 31–Nov. 2 Aero Medical Association 13th Annual Convention, Statler Hotel, Boston, Mass.
Dec. 1–5 American Society of Mechanical Engineers Annual Meeting, Hotel Astor, New York, N. Y.
Jan. 9–11 14th Annual All American Air Maneuvers at International Airport, Miami, Florida.
Jan. 12–16 1942 SAE Annual Meeting and Engineering Display, Book Cadillac Hotel, Detroit, Mich.
April 23–25 5th Annual Southwest Aviation Conference, Hotel Muehlebach, Kansas City, Mo.
April 23–25 Women's National Aeronautical Association Annual Convention, Hotel Phillips, Kansas City, Mo.

Role of Combat Aviation is Worked Out In the Country's Biggest Peaeetime Tests

One major objective of the Army maneuvers in Texas, Louisiana and Mississippi during September was to work out the role of combat aviation in a major battle involving mechanized and mixed ground forces. For this purpose the Army created two Air Task Forces composed of combined tactical and observation units of the Air Force Combat Command to support the Second and Third Armies.

The Southern maneuvers, largest in the peace-time history of the United States, will cover an area about 195 by 150 miles, and will involve about 1000 military airplanes. The new Douglas A-24 dive bomber will be used for the first time as a tactical group in the maneuvers, and in that connection, it was thought activation of the Army's first dive bomber squadron would be announced. Opinion was, also, that the new Curtiss P-40F, powered with the Rolls Royce Merlin manufactured by Packard, might run off some of its tests in the maneuvers.

The 2nd Air Task Force, with a maneuver strength of about 825 officers and 5700 enlisted men, was under the command of Maj Gen. Millard F Harmon, commander of the Second Air Force. Air Force Combat Command. This task force was assigned to the Second Army. The 3rd Air Task Force maneuver strength 1019 officers and 8800 enlisted men was under the command of Maj Gen H. A Dargue, and was assigned to the Third Army.

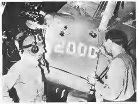
Artemus L. Gates Gets Top Naval Aviation Job

There seems to be nothing mysterious about the appointment of Mr Artemus L. Gates to the office of Assistant Secretary of the Navy for Air, except that more work is piling up, and responsible executives work better with some kind of title.

Artemus L Gates

The office of Assistant Secretary of Navy for Air along with identical offices for the departments of War and Commerce, was created by Congress in 1926, when aviation was first recognized as important. Dr Edward P Warner filled the Navy job from 1926 to 1929, and David Ingalls from 1929 to 1932. Mr Ingalls then went on leave of absence for several months, and the office has been vacant ever since. The War and Commerce air offices also were vacant for a long time. Robert A Lovett now holds the War portfolio, and Bob Hinckley, although he does not sport the title, is actually Assistant Secretary of Commerce for Air.

ARMY PILOTS of the 20th and 35th Pursuit Groups use TWA as they fly east from Hamilton Field to Dayton to pick up new P-40E Curtiss pursuits for use in the Louisiana maneuvers. L to r, pilots are C D Vincent, H B Wright, G P Mullins, C O Wesley, T L. Frost, R R Montgomery, J D C Robinson, R L Delashaw, H E Hammond, B F Beach and B F Percell. Gal is Doris Bergeron.



LIEUT. COL. RAY G HARRIS about to take delivery on the 2,000th Stearman trainer that has been built for national defense. Under the guidance of Gen'l Mgr J E Schaefer Stearman has done a remarkably fine job in building primary trainers.

Air Foree Exercises To Test Coast Defense

Air Force Combat Command units will carry out exercises during October to test the effectiveness of the Eastern seaboard defense against hostile aircraft.

Under the direction of Lt General Delos C Emmons, Commanding General of the Air Force Combat Command, the 1st Interceptor Command, with headquarters at Mitchel Field, Long Island will conduct exercises from October 9 to 16, 1941, covering the northern part of the seaboard from the Virginia-North Carolina line north to include Boston.

The 3rd Interceptor Command, with headquarters at Drew Field, Tampa, Florida, will conduct similar exercises in the southern region of the seacoast from October 20 to 25 1941. This area includes North and South Carolina and Georgia.

British Front Reports

RAF claims an operating strength two-fifths greater than a year ago, despite war casualties, and a higher percentage of reserve aircraft than ever before in its history. British bombers made twice as many daylight raids, and dropped four times as many bombs during July as compared with the same month last year, according to the latest official report which credits delivery of American Flying Fortresses with an important role in achieving this record.

Recently, incendiary missles have been concentrated on the cork forests of Sardinia because "it was learned" that the Nazis depend on cork supplies from this Italian island for use in aircraft manufacturing and insulation for cold-storage plants. The British say Germany, unlike the U S and England which can use balsa wood, has no substitute for cork.

A London Telegraph correspondent reports that Russia is now using American airplane detectors such as those employed for spotting planes over London, and similar to Britain's new radiolocator. These are said to be showing up along the Eastern Front.

Defense Organization Has Been Revamped More Changes Are Pending

Washington (AVIATION Bureau)—Creation by the President of the Supply, Priorities, and Allocation Board provides long needed over all planning of the defense program, but it is only the beginning of a general overhauling and tightening up of the defense organization all the way down the line

Exact lines that reorganization will take are not yet clear, and it will be done in a gradual way, but it appears that OPM as such is already on the way out. Already the Knudsen-Hillman OPM board is reduced to something like the status of an office manager, since SPAB is inevitably assuming most of its policy-setting functions.

What will become of the aircraft organization—OPM's aircraft section and the unwieldy structure of coordinating committees and joint committees which ties it to the Army, Navy, and British—is still uncertain. A possible forecast of what may happen is seen here in the recent consolidation of tank activity. The tank section of OPM was combined, early last month, with a newly formed tank unit in Army Ordnance Branch.

Although no concrete action has yet been taken, it is thought that something similar might be attempted in aircraft. The problem would be more complicated, because both Army and Navy would be involved, but shrewd observers inside OPM point out that the rewards in increased efficiency might be great. Such a shift would end the anomalous situation in which men charged with overall planning of the aircraft program have no authority to award contracts. It would end much duplication and overlapping of function and the inevitable delays of clearing all major decisions through two or three agencies

Meanwhile, existence of SPAB is expected considerably to simplify the problems of manufacturers in getting tools and equipment. A major weakness of the priorities system has been that there are too many priorities. Everyone has been given a rating without regard to how much material was available. Consequently there has been continual pressure to raise the rating on military projects (for example, when medium tanks were granted the same A-1-d rating as aircraft). This means that the aircraft industry has found its high ratings steadily decreasing in value. One of the first major jobs of SPAB will be to bring the priority system into more realistic relation to to the supply of machines and materials.

Labor Stabilization Delayed by CIO

Hillman's efforts to put through an aircraft labor stabilization agreement are temporarily at a standstill since the CIO stymied the first attempt by refusing to discuss labor conditions on an industry-wide basis. For the moment this looks like an insuperable obstacle. However, though the prospects for an agreement look much less bright than they did a month or so ago, it would be a mistake to write the whole thing off. Hillman attaches great importance to his stabilization agreements; he is prepared to put his full authority behind them; he has obtained the acquiescence of the employers, and he is in a position to get large concessions for the workers in the industry. This is a combination hard for the CIO to buck.

Too, there are reasons to think CIO's opposition is not adamant. Partly it is motivated by sheer antipathy to Hillman, partly also by fear that the men might come to look to the stabilization agreement for protection rather than to the unions. But the major point seems to be that CIO leaders expect to have a much stronger position in the industry in a few months than they do now

At present CIO controls only one major plane producer—North American—though it has several smaller plants like Brewster, Vultee, Ryan. Vigorous organizational campaigns are underway, however, at Douglas, Consolidated, and Curtiss-Wright. If CIO had these three in its pocket it could walk into a stabilization conference as the dominant aircraft union—which it can't do now

Meanwhile, pending possibility of an industry-wide stabilization, individual firms on the West Coast are negotiating individually with their employees to bring wage levels into conformity with the terms of the North American agreement. That contract, worked out after the government seizure of the plant, provided for a starting wage of 60 cents rising in twelve weeks to 75; it is considered the most favorable to labor yet granted

To date, Douglas, Vultee, and Northrop have adjusted their scales to conform, and Lockheed-Vega has reached an agreement with the AFL machinists, terms of which have not been announced as we go to press.

In other moves symptomatic of the generally rising wage levels in the industry:

Fleetwings granted a 5-cent an hour increase to all employees with three months' service. The company recently installed seniority and vacation systems and a group insurance plan.

Cessna granted a blanket increase of 5 cents to its 2 300 workers.

NOT CONTENT with building a large share of the nation's aircraft engines, Wright Aeronautical is now turning out hundreds of 9-cylinder engines for the Army's M-3, 28-ton tanks. The engine, shown here on a test block at Paterson, has a displacement of 975 cu. inches, gives tank a 30 m p.h. speed.

Press Association

AL BENNETT, test pilot, and Harry Hedges, inventor look over a new aircraft engine designed to produce more horsepower per pound. A monocycle type with fuel injection and no valves, engine was test flown recently. Note air intake with "iris" diaphragm

Kinner Plant

Expansion has been so rapid at Kinner Motors in Glendale, Calif., that the company has constructed a new two-story administration and engineering building which will be finished about November 1. This will give the firm approximately 10,000 sq ft of additional space. The new building is directly in front of the manufacturing building on ground which the company formerly leased but which has now been purchased

New Push Started For Sub-contracting

Washington (AVIATION Bureau) A new drive has begun in Washington to increase the sub-contracting of defense orders, so as to get every possible small plant in the country working on armament. There has been talk about sub-contracting for months, and this device was used to bring the big auto manufacturers into aircraft work, but as far as bringing in the small producer is concerned, sub-contracting has remained talk.

But the growing scarcity of metals is forcing hundreds of small manufacturers to curtail operations or shut down, may throw as many as a million men out of work within a few months. The result has been heavy political pressure, and this time Washington means business about splitting up the work.

The President has created in OPM a new Division of Contract Distribution headed by a Wall Streeter, Floyd (50 cents on the dollar) Odlum. This division, when prime contracts are let, will arrange with the contractor as to how much sub-contracting he can do, it will review applications for priorities on new machinery to see whether the work couldn't be subcontracted instead. And it will study the possibilities of businesses stranded by material shortages and recommend award of prime or sub-contracts.

Lockheed Labor

Much to the surprise of Lockheed officials, and also national representatives of the A. F. of L., the Lockheed Aircraft Corporation local A F of L union has rejected a model employer-employee agreement which would have resulted in annual wage increases of more than $16,000,000. The contract had been drawn up through negotiation between factory and union representatives under the auspices of the O P M and other government services. In addition to pay increases the proposed agreement had provided for greater vacation time, sick time, and other benefits.

Negotiations are continuing on behalf of the 46,000 Lockheed and Vega employees, with the management, in an effort to eliminate the one objectionable provision on which the union action was reportedly based, an indefinite provision for an increase of 5 to 12 cents an hour for skilled craftsmen in the plant, with detailed increase to be worked out at a later date. The men are believed holding

CELEBRATION of the 400th Menasco engine built for Canada at the Burbank plant, three months ahead of schedule. Robt. Insley, chief engineer, left, congratulates Joseph Babcock, factory mgr.

out for a blanket increase of 12 cents per hour for all skilled craftsmen.

Douglas Deliveries

Douglas Aircraft Company reports an increase of 70 percent in airplane deliveries for the first six months of its 1941 fiscal year over the same period of 1940. Gross billings for the six months ended May 31, 1941, were $53,322,687. Net profits for the period were $4,139,282, against $3,388,856 from sales of $25,288,525 in the same period of 1940. It will be noted that while the gross profit figure increased substantially, there is a considerable decline in the ratio of profit to sales over the previous period, largely accounted for by increased taxes. Further wage increases made since May 31st, and to be made in the future, will further reduce the ratio of future profits it is believed. Douglas now employs about 35,000 people and expects to jump this figure to 75,000 in 1942, when the Long Beach and Tulsa plants are in full operation.

Bendix Aviation, Ltd., expects to move into its new $2,000,000 Burbank factory, now under construction, about Nov 1st. With three buildings totalling 113,500 sq ft. of floor space, on a 20-acre site, this will be one of the country's most modern and fully equipped aircraft hydraulic and electrical accessory production plants. Modern fluorescent lighting is installed throughout to make possible a full 24-hr work schedule. Firm has maintained three full shifts in its machine shop, providing for maximum machine use, for more than a year in its present location.

ASSEMBLY LINES

Robert Colborn

Production, after bumping along for three months just under 1,500 units, rose in August to

AN EVEREL CONSTANT SPEED PROPELLER used with a Lycoming geared 75 engine. This propeller has improved take-off distance and rate of climb as much as 20 percent in some tests. Made by Everel Propeller Corporation of Baltimore, Maryland.

1,854 and the increase, it appears, was largely in combat types. August production, however, suffers even more than previously from an unbalance on the side of pursuit.

Much of the increase over July figures is in pursuit ships, with Bell getting into mass production on its P-39 (Airacobra). There was, however, a substantial increase in four-engine bombers.

Unbalance was already great enough in July. Of some 750 combat ships delivered that month it is unofficially estimated that 400 were fighters, 125 light bombers, 175 medium bombers, and 50 heavy bombers.

Floor space devoted to production of planes, engines and props had risen by the beginning of August to nearly 42,000,000 sq ft as compared with 25,500,000 at the beginning of the year. In these plants, 304,000 men were working, a total during July of more than 82,000,000 man hours—equivalent to the labor requirement for building 500 heavy bombers.

First Curtiss P-40 mounting a Packard built Rolls Royce engine, as previously stated in this column, has now been delivered to the Air Force. It is the P-40F and is generally similar to the other models in the P-40 line, which are Allison-powered. The P-40D is currently in quantity production.

Packard now has a real assembly line in operation on the Rolls Royce Merlins, but will not reach capacity production of 800 a month until next spring. The Merlin is a 12-cylinder Vee developing about 1,300 hp.

Allison, meanwhile, has doubled its output since the beginning of the year and is in real quantity production. It is still, however, somewhat behind the schedule, which calls for 1,000 in August rising to 1,600 a month by year-end. All production is now on the 1,350-hp model. Allison is said to be nearly ready to go on its 2,000-hp engine, a 24-cylinder W with two crankshafts.

Republic has completed its first contract for about 40 of its P-43 (Lancer) fighters, achieving a production rate in August of something like 25 a month, and is now working on a second contract. The P-43 is powered by a 1,200-hp P & W. A prototype has been delivered of Republic's 2,000 hp P-47 (Thunderbolt), but quantity production waits on the availability of engines and propellers.

Most of the 2,000-hp P&W's are now going into Vought shipboard fighters and Martin B-26s. Props in this size are extremely scarce, and the backlog of Martin bombers without propellers is still increasing.

A substantial increment of the big engines is expected this fall, as Ford is starting to build them this month and hopes to hit a full thousand a month by January.

Airplane building at Ford won't start until Spring, when production is to start on four-engine Consolidated bombers, working up to an output of 75 bombers a month, and subassemblies for 100 more to be put together in government assembly plants.

Stearman built its 2,000th primary trainer late in August.

Manufacture of North American advance trainers for the Air Force has been transferred from Inglewood to the new plant at Dallas. They will be built at Inglewood for the RAF for a few months more, and then the entire Inglewood plant will be devoted to P-51 (Mustang) pursuits and B-25 bombers.

Two new military versions of the Douglas DC-3 transport are now being tested by the Air Corps. The C-47 has a large loading door and a floor reinforced for heavy freight. The C-53 is equipped only for light cargo. Both have folding benches to accommodate 28 parachute troops.

Aluminum price dropped, for the second time this year, to 15 cents a pound. Reduction was part of a deal with the government involving federal financing of new plant expansion.

War Department plans to inaugurate a $200,000 research program on aeronautical uses of wood.

Increasing demand for plastics has resulted in priority control and price regulation on formaldehyde, the basic ingredient.

General Aircraft wanted to demonstrate to the Army how quickly anyone can learn to fly its spinproof Skyfarer. But CAB regulations require eight hours instruction before solo, thus stymying the demonstration. So CAB finally exempted soldiers flying Skyfarers from the rule for two months.

Schweizer Aircraft, builder of a two-place metal-frame sailplane, is redesigning its ship for wood and expects to be on the market in January. Schweizer is entirely devoted at present to building two-place sailplanes for the Army and is also designing a 15-place job.

Kinner Motors, Inc., has greatly improved its position as a major supplier of training plane engines, according to a report from Earl Helling, vice-president and general manager. A recent Army order of $745,342 for engines and spare parts brought the engine backlog to $3,800,000. Further expansion of the Kinner plant is being undertaken.

Net profits of Kinner Motors for the fiscal year ended June 30, 1941, are reported at $140,787.96 after all charges which more than doubles the preceding year.

OUR NEWS ITEM on Charles H. Colvin in the September issue gave the impression that his primary connection was with the Weather Bureau. Actually, he is now Director of the School of Aeronautics of New York University, but remains as technical consultant at the Weather Bureau.

Plant Expansion

Bell Aircraft Corp. is increasing its Niagara Falls fighter plane factory from 240,000 sq ft to more than 850,000 sq ft of space. Defense Plant Corp. is putting up $8,458,175, including $2,853,251 for machinery and equipment and about $1,300,000 to take over existing facilities built within the last 10 months. The factory itself will be increased by 555,000 square feet, including mezzanine floors in the existing 600 by 400 ft structure and a large basement.

American Bosch Corp., Springfield, Mass., plans a new $2,000,000 plant to provide additional production capacity for aviation magnetos. The new 3-acre plant will be one of the largest factories in the world devoted exclusively to the manufacture of magnetos.

Eaton Manufacturing Co., Wilcox-Rich Division, Cleveland, Ohio, is building a plant at Saginaw, Mich., at a cost of $465,235, to be used in the production of aircraft parts. Approximately $406,700 will be used for land and buildings and $58,535 for machinery and equipment. This will be in addition to previous authorizations totaling $2,312,283.

Although Vega has just started production in its new Burbank plant, a $1,822,713 expansion program has been announced by Courtlandt S. Gross, president. The expanded facilities will be used in connection with the B V D scheme for mass production of Boeing Flying Fortresses and will consist chiefly of a large new assembly hangar building to be erected on Lockheed Air Terminal.

Canadian Aviation News

By James Montagnes

Manufacture of all-wood and fabric airplanes of the so-called "plastic" type may be the next step in Canada's expanding aircraft production program. Royal Canadian Air Force officials are now making final decisions on this step, and a plant at Belleville, Ontario, is being prepared to go ahead with mass production if the decision is favourable. An all-wood Avro Anson fuselage, assembled at the air force operational headquarters at Rockcliffe, Ottawa, has been exhaustively tested and proven, delivering 10 miles an hour greater speed than that of the orthodox metal-fuselaged Ansons now in general use. The fuselages are made under the Vidal laminated wood process. Anson and some other types of trainer planes already are made with wood and fabric wings and use of this new type of construction for fuselages would mean production of an all-wood and fabric machine, for which there is ample raw material available in Canada.

Several changes have been made in the operating department of Trans-Canada Airlines, the publicly-owned transcontinental air line, according to an announcement by O. T. Larson, vice-president. R. F. George, superintendent of flight operations, becomes operations manager with jurisdiction over the entire TCA system. H. H. Kenyon and F. M. McGregor were appointed operations superintendents at Lethbridge and Toronto, B. A. Rawson has been moved to assistant operations superintendent, and E. P. Wells, assistant superintendent at Toronto, was moved to Winnipeg as assistant superintendent in the office of the operations manager. W. J. Dalby, western division traffic manager, moves up to succeed G. G. Wakeham as general traffic manager.

Trans-Canada Airlines is taking an active part in the Dominion's war effort, with the line's instrument shop at Winnipeg working full time on the overhaul and repair of aircraft instruments for the Royal Canadian Air Force. The line's facilities at various airports across Canada are extensively used for military aircraft, and radio coverage is furnished when it is required.

Operations and organization of the western air lines acquired during the past year by the Canadian Pacific Railway are being merged with that of the parent company. Services of Mackenzie Air Service have been coordinated with certain services of Canadian Airways in the Mackenzie River area between Edmonton and the Arctic Ocean and on the Edmonton-Prince Albert, Sask run. These operations have been placed under operation of a third company acquired, United Air Service. The coordinated services are operated under the general direction of an advisory board composed of representatives of Canadian Airways, Mackenzie Air Service and the C.P.R. The railway does not own Canadian Airways in its entirety, but has a considerable holding in this pioneer northland operating company. The C.P.R. has also obtained Starratt Airways and Transportation, operating in northern Ontario, Ginger Coote Airways, operating on Vancouver Island, and Yukon Southern Air Transport, operating from Edmonton into the Yukon along the route of the defense airway being built through northern British Columbia to link with airways in Alaska. Mackenzie Air Service in August began a million dollar plant expansion at Edmonton, including additional hangars, warehouse, engine testing stands and other buildings. The expanded plant will overhaul Oxford, Avro Anson and Fairey Battle planes used in air force training.

Five Hundred Percent Production Increase for Australia. Production plans now being formulated for Australia's aircraft industry call for a production in the next 12 months doubling production attained in the previous 30 months, constituting a 500% increase in capacity. As this program was being made public, the first Australian built Beaufort torpedo bomber is breaking all Australian records on a continent wide test and demonstration flight. Other aircraft being produced include the Wacket and Wirraway, while the C.A. 4, Australian designed bomber and the Bristol Beau-fighter are to go into production shortly.

Thirty-five transports, modified from the military type used in this country, were promised to China to speed up delivery of war materials, and will probably be taken from the current production line at Douglas Aircraft.

On Schedule

By "Vista"

The formation of two subsidiary companies by Pan American Airways, named Pan American Africa Ltd., and Pan American Air Ferries, was one of the pieces of news which came into the foreground more than others during the past month. Pan American flying base experts are traveling through Africa, establishing suitable bases on the West Coast, and reportedly one Boeing 314A has been sold to the U.S. Government, who indirectly sponsored the two new daughter organizations, and who will in turn let this flying boat be operated by Pan American personnel. The reason for this move is rather obvious, the present Neutrality Act forbids the use of civil American equipment in the "War Zone", whether airplane or steamship, and this restriction can only be lifted by the use of government aircraft. In addition, Army pilots will probably be released to operate the aircraft being flown to Africa by P. A. Air Ferries, while the establishment of air bases so near Dakar in French West Africa and the training of American flyers on long distance flights with equipment which is actually being used in the present war, will be invaluable if this country has to defend its rights.

The elimination of Axis airlines in South America is being continued with evident success by this country's government and airlines. Last month the German airline L.A.B. in Bolivia was replaced by Pan American Grace, this month the Ecuadorian Government suspended all operations of the Sedta, one of the many hydra-like tentacles of the German Condor system, and granted exclusive rights to P. A. Grace. Some of the criticism which has arisen from the attempted elimination of German controlled and piloted airlines, since they do open parts of the interior which could otherwise only be reached after long journeys (and might make swell hide outs), will be overcome through a proposed training program of Latin Americans in this country, to be run by the C.A.A. under the supervision of the War and State Departments, starting this December at a cost of $1,500,000. Quite a few of the South American countries already have rules whereby the copilots of foreign-owned and operated airplanes have to be nationals of the country of origin, and it is more than likely that this rule will be extended to include all flight personnel, as soon as this personnel has been trained.

Undaunted by a general refusal in May of this year, Air France, which now goes under the name of "Réseau Aérien Français", and which has been attempting, quietly but vigorously, to reopen routes once operated by the German DLH, once again applied for permission to fly from Dakar to Brazil and from Brazil to Buenos Aires and Santiago de Chile. As before, permission was refused again for this line, which apparently would be operated with aircraft stored in Argentina in June 1940, and whose main purpose appears to be a lightening of the Italian LATI's burden, now badly overworked and facing imminent shortage of fuel and materials. Though permission has apparently been obtained from Argentina for services in and out of that country, the necessary franchises do not seem to be forthcoming from other Latin American republics.

Speaking about Dutch air services, the KNILM, government controlled and subsidized airline in the Far East, recently celebrated 12½ years' operation. This line now covers about 10,300 miles in the Far East mostly with American equipment, with Singapore, Sydney and Saigon as its most important terminals outside the Netherlands possessions. Other airlines still operated by "Free Dutch" interests are the KLM line from Palestine to Java, now being flown twice-weekly to eliminate a bottleneck apparently created by the diversion elsewhere of British airline equipment, and the well-known London to Lisbon line, operated with DC-3s.

Recent Awards

Bendix Aviation Corp., South Bend, Ind. $139,062 for carburetors and spare parts.
Aluminum Co. of America, Pittsburgh, Pa. $433,095 for rivets.
Pump Engineering Service Corp., Cleveland, Ohio. $137,900 for pump assemblies with valve.
Jack & Heintz, Inc., Cleveland, Ohio. $227,490 for maintenance parts for starters.
Bendix Aviation Corp., Sidney, N. Y. $125,875 for parts for magnetos.
Breeze Corp., Inc., Newark, N. J. $286,360 for flowmeters.
Standard Steel Works, North Kansas City, Mo. $459,000 for stand assemblies.
Magnavox Co., Inc., Fort Wayne, Ind. $128,826 for solenoid assemblies.
Ohio Chemical & Mfg. Co., Cleveland, Ohio. $262,425 for oxygen mask assemblies.
Bendix Aviation Corp., Sidney, N. Y. $216,290 for assemblies.
Vultee Aircraft, Inc., Downey, California. $292,460 for adapter assemblies.
Allith Prouty, Inc., Danville, Illinois. $285,300 for sheding assemblies.
Leece-Neville Co., Cleveland, Ohio. $118,311 for generator base switch and assemblies.
Bendix Aviation Corp., Sidney, New York. $291,712 for items for parts.
Sharpsville Steel Fabricators, Inc., Sharpsville, Penna. $433,400 for tanks.
Jack & Heintz, Cleveland, Ohio. $7,833,800 for starter assemblies.
Douglas Aircraft Co., Santa Monica, California. $176,316,690 for airplanes and parts.
Bendix Aviation Corp., Bendix, N. J. $275,538 for miscellaneous parts.
Bell Aircraft Corp., Buffalo, N. Y. $75,218,384 for airplanes and spare parts.
Wright Aeronautical Corp., Paterson, N. J. $19,248,810 for maintenance parts for engines.
North American Aviation, Inc., of Texas, Dallas, Texas. $6,990,612 for planes and parts.
Weston Electrical Instrument Co., Newark, N. J., $108,129 for indicator assemblies.
Holley Carburetor Co., Detroit, Mich. $131,782 for carburetor assemblies.
Jaeger Watch Co., Inc., New York, N. Y. $118,169 for clock assemblies.
Rolls-Royce, Inc., Detroit, Mich. $168,022 for tools for engines.
International Engineering, Inc., Dayton, Ohio. $243,991 for lamp assemblies.
Aerial Machine & Tool Corp., New York City. $324,920 for mount assemblies.
Fleetwings, Inc., Bristol, Penna. $4,555,614 for airplanes and parts.
Cessna Aircraft Co., Wichita, Kansas. $12,043,865 for airplanes and parts.
Curtiss-Wright Corp., Buffalo, N. Y. $772,800 for wing panel sets.
Dowty Equipment Corp., Long Island City, N. Y. $757,200 for assemblies.
The Denison Engineering Co., Columbus, Ohio. $631,737 for hydraulic test stand assemblies.
Kinner Motors, Inc., Glendale, Calif. $745,342 for engines and parts.
Curtiss-Wright Corp., Robertson, Mo. $28,153,924 for airplanes and spare parts.
North American Aviation, Inc., Dallas, Texas. $1,340,788 for airplane maintenance parts.
Fairchild Engine & Airplane Corp., Hagerstown, Md. $4,746,951 for planes and parts.
Curtiss-Wright Corp., Buffalo, N. Y., $168,014 for parts for airplanes.
Republic Steel Corp., Massillon, Ohio. $377,300 for steel rods, medium carbon, etc.
Master Electric Co., Dayton, Ohio. $138,844 for generator sets.
General Electric Co., Schenectady, N. Y., $797,874 for superchargers.
Bendix Aviation Corp., Bendix, N. J. $170,833 for indicators.
Electronic Laboratories, Inc., Indianapolis, Ind. $126,000 for inverters.
McCauley Steel Propeller Co., Dayton, Ohio. $340,067 for propeller blades.
Bendix Aviation Corp., Sidney, N. Y. $289,518 for Scintilla magnetos.
Western Industrial Engineering Co., Los Angeles, Calif. $225,300 for magnetic inspection apparatus.
Bell Aircraft Corp., Buffalo, N. Y. $158,400 for adapter assemblies gun mount.
Homelite Corp., Port Chester, N. Y. $2,341,290 for gasoline engine driven generator.

Navy Department

None


The four men appointed by President Roosevelt to serve with W. Averell Harriman on the British American mission to Moscow, are (l.) MAJOR GENERAL GEORGE H. BRETT, chief of the Army Air Corps, (r.) WILLIAM L. BATT, deputy director of the production division of the Office of Production Management Major General James H. Burns, and Admiral William H. Standley. Lord Beaverbrook heads the British Mission.

Underwood

A ferry plane crash in England on Aug. 14 fatally injured Arthur B. Purvis, chairman of the British Supply Council. MORRIS WILSON (above) succeeds him and E. P. Taylor is named vice chairman.

For past three years hydraulics engineer at Lockheed WILBUR G. WOOD has resigned to become chief engineer of Menasco Manufacturing Co.'s new hydraulic strut division, now being expanded.

"It's safe to fly" says DICK DEPEW on the occasion of the 30th anniversary of his first solo flight. Depew, vice president of Taylorcraft Aviation, has been active in every phase of aviation.


Harris & Ewing

Relief Wings, incorporated a year ago for "humanitarian service by air", has grown rapidly, according to executive director Ruth Nichols. O. M. MOSIER (l.) has accepted the post of co-ordination chairman, and has appointed CASEY JONES (r.) national chairman to head pilots and planes throughout the country, to prepare them for any peacetime or wartime civilian emergency. Headquarters are at 342 Madison Ave., N. Y. C.

COL. WILLIAM E. LYND, who has been appointed Chief of Staff of the Air Support Command, was formerly Air Officer of the General Headquarters in the War Department. (See AVIATION, Sept., 111.)

Starting with Kinner Motors 13 years ago as an inspector, WALTER G. MILKA has advanced to his present post of production manager, and has now been elected a member of the board of directors.

ROBERT S. VAN CLEVE, formerly sales manager of Bendix Radio and Lear Avia, has been appointed sales manager of the rapidly growing Kansas City, Kans. division of Aircraft Accessories.


The erection of Bendix Aviation's new plant at North Hollywood, Calif., is in charge of MEL M. BURNS (l.) assistant general manager. R. C. FULLER (r.) sales engineer, has been introducing the company's line of hydraulic equipment and tube clamps, heretofore furnished to western manufacturers to eastern plants. The plant doubles present facilities and will be ready for occupancy on Nov. 1st.

DR. JOHN CAMPBELL, technical director of International Paper Co. since 1929, is now with Reynolds Metals Co., in charge of the department devoted to improvement of manufacturing methods.


EDWARD A. OBERHAUER (l.) and Roy H. Clever, appointed service representatives on Ryan PT-21 Army and NR-1 Navy primary trainers, are now stationed respectively at the Navy's Jacksonville base, and the Air Corps' school at Palo Alto. JOHN C. ZIPPWALD (r.), formerly assistant foreman, has been named special service representative of Ryan's manifold department, to work with aircraft manufacturers.

Rotol Contra-Prop

With ceilings for airplanes constantly going up under pressure of wartime needs, the ever persistent problem of converting power into thrust is more and more occupying the attention of designers. One answer to this problem has been advanced in the shape of a counter-rotating propeller.

The contra-prop received some attention in this country by Curtiss-Wright, which tried out an adjustable pitch counter rotating propeller, consisting of two two-bladers, on a P-36A in 1939.

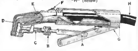
In England, the Rotol Air screws, Ltd., has produced a counter-rotating propeller which basically is a normal pair of 3 bladed hydraulically operated, full feathering, propellers. Mounted in line on a common center at a spacing of 15 in., the Rotol contra-prop is driven by two concentric shafts revolving one within the other. Both shafts are driven from the same engine by means of suitable reduction gear.

Although weight is naturally increased in the contra-prop, it is found, according to the British, to be only 10 percent approximately for any particular installation. To this must be added the weight of the reduction gear, between 70 and 100 lb., which, including the weight of the contra-prop, does not bring the total weight of the installation above 30 lb per b.h.p.

The only other disadvantage besides the slight weight increase is the need of greater maintenance because of increased complication. This is outweighed by the advantages which include elimination of swing at take-off because slipstream is straight on the tail unit, elimination of swing upon sudden opening or closing of the throttle in dog-fights, thus enabling the fighter pilot to keep the enemy in the sights even when shutting off the throttle to avoid over-shooting, improved handling characteristics because of the elimination of torque and straightening of slipstream, reduction in propeller diameter, in landing gear height and spacing of engine nacelles, absorption of power at high altitudes.

Rotol contra-rotating propeller

COMPLETELY INSULATED: a new Safe Arc electrode holder (above) has been brought out by M. L. B Mfg Co., Hollywood, Calif. Insulation is made of special asbestos base material and is completely covered by metal. Operator and work are thus protected from arcs and flashes, and increasing life of holder. General agent, Joseph Becerra, Suite 812, 1450 Broadway, New York City. Structural features of the new Safe Arc holder are: toggle joint "A" for easy operation and powerful grip, adjustment nut "B" for different size welding rod; taper plunger which grips rod, asbestos base molded insulation "D"; cable connection "E"; screw "F" for dismantling holder, fiber-covered, metal handle "G", and welding cable "H" (below)



Bullet-Sealing Hose

Development of a bullet sealing hose, eliminating an "Achilles' heel" in the armor of America's combat planes by protecting vital fuel systems from punctures, has been announced by the B. F. Goodrich Co., Akron, Ohio.

New type hose not only protects fuel systems but also makes possible substantial weight savings in the average bomber. The development is an outgrowth of self-sealing tanks. The bullet-sealing hose eliminates the weight of auxiliary metal fuel systems which were needed to guard against the hazard of punctures to main fuel lines. Secret of the hose's construction is an unusually effective sealing member that prevents fuel leaks even under 10 to 15 lb pressure and despite numerous punctures from high caliber machine gun bullets. The inner surface is a layer of the synthetic rubber Ameripol which is highly resistant to oil and gasoline.

Principal use of the hose, which has a total wall thickness of less than 5/16ths of an inch is to connect fuel tank cells and engine supercharger systems. Although punctured five times, two of the holes being indicated by chalk rings, this section of bullet-sealing hose held fuel under 10 to 15 lb pressure without leaking. Fifty caliber machine gun bullets, one of which is shown with the punctured hose, were used in the tests.

Bullet-sealing hose punctured by 50 caliber bullets, held fuel under pressure

New Brake Lock

To fill the need for a means of locking hydraulic brake systems through means other than a latch on the brake pump cylinder, the Hydraulics Department of Morrow Aircraft Corp., San Bernardino, Calif., has developed a light weight unit that is placed between the pump cylinder and the brake cylinder which is said to positively lock the brakes and maintain a uniform pressure on the brake system regardless of temperature. Problem has been to avoid loss of pressure due to contraction of the fluid when temperature drops, or the building up of excessive pressures due to a raise in temperature between the time brakes are locked and the time they are finally released.

Tests with the brake lock have been completed, with particular emphasis on a leak-proof system and one that is automatically balanced regardless of outside air temperature. Locking control is with a Shakespeare wire control system mounted on instrument panel and extending to each of the brake locks that are interposed between brake pump cylinders and wheel brakes. Weight of unit is only 14 ounces, and will handle pressures up to 400 lb per sq in.

Hydraulic brake lock developed by Morrow Aircraft Corp.

Export Builds Hangar

American Export Airlines refused to comment, when asked by AVIATION, whether they planned to start transatlantic operations without an airmail contract. You will recall that this possibility was discussed by the press at the time Congress rejected an appropriation to pay for mail transport by Export, and officials did not deny that they had such plans in mind.

The company broke ground recently at La Guardia Field for a hangar, described by the Mayor himself as "New York's first concrete contribution to post-war adjustment." Jim Eaton, Export executive, told AVIATION that his firm is well pleased with the three Sikorsky S44a 16-passenger long-range planes which are taking shape at the plant. The first of them will probably be delivered in November.

Informed observers say that large numbers of persons, especially on the European side, would cross the Atlantic if they could get transportation. Presumably Export could load up to capacity.

Pilot Contracts, Pensions

Pilot contracts with all the domestic airlines except National Air Lines have now been consummated, the Air Line Pilots Association announced following signing of an agreement with Eastern Air Lines.

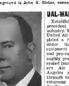
Conferences with NAL before the National Mediation Board adjourned during the summer are expected to resume shortly, ALPA officers said.

Meanwhile the pilots association which previously exerted pressure for pilot pensions is soft-pedaling because of more pressing "defense matters." United and Pan American are the only two airlines offering a pension plan. American Airlines which has been toying with the idea is also side-tracking it for the time being. The working out of a pension system involves many complications.

Gorrell Serves OPM

C. R. Smith, president of American Airlines has resigned as consultant on domestic aviation to the Transportation Division of OPM, and has been succeeded by Col. Edgar S. Gorrell, head of the Air Transport Association.

MAYOR LA GUARDIA breaks ground for American Export's new hangar at La Guardia Field, New York, adjoining PAA hangar. In left foreground is John E. Slater, executive v-p. for A.E.



Col. Edgar S. Gorrell

OPM officials spoke highly of Mr. Smith's work with the government, and they told AVIATION that he had been compelled to leave this and other Washington jobs because of the pressure of his company duties.

As yet the Transportation Division of OPM has exercised no important functions with regard to aviation, but it might do so at any time. Right now it is working with the Ickes office to make sure of the airways' gasoline supply. And if the matter of seat preferences for defense travel should become urgent, the Division would be called upon to act.

Operations of Western Air Lines for the six months ended June 30th, last, showed a net loss of $59,333. Despite increasing traffic and expanding operations the higher costs of operation have whittled down profits from the $71,152 shown for the corresponding period of last year, according to President Wm. A. Coulter.

UAL-WAL Interchange

Establishing an important precedent for the entire airline industry, Western Air Lines and United Air Lines have now completed a full year of operation under their interchange of equipment scheme. Maintenance cost pro-ration has proved thoroughly practical. Planes are operated interchangeably, a Western Air Douglas from Los Angeles sometimes going on through to New York and then returning to Seattle before finally getting back to Los Angeles base. Overhauls are a matter of routine procedure. An engine and plane log is carried on all planes and both companies make a monthly check of operations performed, with balancing billings to properly credit or charge all work done on materials or equipment used, such as spark plugs, tires, etc. All items are listed under a fixed schedule and charged equally by both lines.

DC-3 Jump to Hawaii

Three new Douglas DC-3s recently were flown 2450 miles from San Francisco to Honolulu, completing the longest formation over-water flight by commercial land transports in aerial history, according to Company officials.

The planes took off from Oakland Field at 5:15 a.m. and 13 hours and 55 minutes later landed at John Rodgers Airport in Honolulu.

Delivery of the craft was authorized by OPM to Hawaiian Airlines, long known as Inter Island Airways, to augment its fleet of amphibians. The Hawaiian lines are important in Pacific defense.

The planes were in constant radio communication with each other and with both the mainland and the islands.

Company representatives told AVIATION that the DC-3s carried special fuel loads of about 1622 gallons, as compared with normal capacity of 825 gallons.

Airline Prospects

Washington (AVIATION Bureau)—The airlines are feeling optimistic about their prospects for aircraft. The Joint Aircraft Board (Army, Navy, the British) has approved the Air Transport Association's request for about 175 airplanes to go into service during 1942 and early 1943.

This, of course, is subject to change. Extreme emergency might still cause production to be stopped or turned to the British. But if the war goes against the Axis and U. S. plane production goes well, it may be that the airlines can have all the planes they can use. The Administration is anxious to have all the air seats it can get for defense business.

The Priorities Division of OPM has given Douglas permission to go ahead with production of the DC-4, airline orders for which were taken over by the Army. The Army might release all 60, or any part, to the airlines. At least one airline tells AVIATION it would be glad to have some DC-4s. The same line expressed opinion that the industry would welcome a number of Lockheed Constellations, in addition to those on order to Pan American and TWA. Authority to go ahead with Constellations seems also to have been granted by OPM. Some of the small lines, in one executive's opinion, would like to get some Lockheed 14s or Lodestars.

The aircraft deficiencies of the different lines are reported to be approximately equal. The lines have pooled their requests with the Air Transport Association. The replacement program does not start until June, but meanwhile the Association will go to the Joint Committee with any emergency requests for planes for any specific line.

Air Pick-up Pays

Although the airmail pick-up service of All American Aviation has been in regular operation only a year, it is already repaying the direct cost to the government, says Rep. Jennings Randolph.

The Congressman, who sponsored the Federal legislation authorizing this development in air service, reports that during the first year, 92 percent of daily schedules were completed, 663,727 miles flown, and 32,000 pick-ups and deliveries made "without losing a single piece of mail or express and without a serious flying mishap."

While only 109 communities are now served, applications are pending before CAB to open airmail pick-up routes to 1800 additional towns.

African Service

(Continued from page 111)

within Africa, by means of connections with British and Belgian lines to South Africa and the interior; (3) ferry U.S.-built war planes via the "Narrows" to Africa and to the Middle East for the British.

Pan American Airways-Africa, Ltd., will operate the transport service in Africa. Pan American Air Ferries, Inc., will fly the war planes across the Atlantic and to the East Mediterranean. The additional service, New York to Africa, will be under a CAB extension certificate.

The New York-Leopoldville line will run to Puerto Rico and Trinidad, providing direct services to these two U.S. defense bases. Thence South, across the Amazon to Natal, Brazil, across the Atlantic to Monrovia, Liberia, (just under the western hump of Africa), down the Ivory and Gold Coast through Nigeria to the trade port of Leopoldville on the Congo River in the Belgian Congo. Provision is made in the application for alternate use of Bathhurst, some 900 miles north. Over-water distance from Natal to Monrovia is 1810 miles. Leopoldville is the shipping point of many strategic defense materials obtained in Africa.

No information was available on schedules or on construction of airports and airways aids.

PAA's application said that Boeing 314A flying boats would be used on the transatlantic run. The last three of an order for six of these have been delivered, (the first three were turned over to the British). The President said that government-owned equipment would be used, too. He might have meant that some bombers would be put in the service, or that the 20 DC-3s recently rounded up for the British, for use in the East, would be returned for use by PAA—or both. It is still a matter of speculation whether OPM is allowing Lockheed to go ahead with the 4-engined "Constellations" which PAA has on order.

Pilot personnel will be a problem, of course. It was said, unofficially, that the Army would allow numerous pilots to resign and accept jobs with PAA on both ferry and commercial service.

Airline Doings

United Airlines, Pacific Coast line had its fifteenth birthday in September. Company introduces lowest per-mile rates in air transportation on week-end excursion flights. Examiner's report and subsequent action of CAB on request to operate passenger-cargo schedules Washington-Toledo, are awaited. 100 more pilot students will be enrolled beginning Nov. 1. Ninety-five students were enrolled in the first four classes at the UAL-Boeing school starting last October. Company develops new-type adjustable airplane cleaning stand and orders manufacture of same. More than 2,000 employes of UAL have been paid over $145,000 under health and accident insurance program made available in November, 1934.

Trans-Canada declares Canada has finest flying country in the world and a well-established service, we are placed so we have the shortest route right around the world—both ways.

TWA completed weighing 5 Stratoliners, largest transport planes in domestic service, placed in operation a year ago. Empty weight of each was approximately 31,290 lb.; gross weight including all accessories and passengers is 45,000 lb. Special scales were required.

Braniff Airways adds three new round trips daily Chicago-Texas-Mexico and resumes a new fourth round trip daily Oklahoma City-Dallas. T. E. Braniff, president stated the new runs would make a total of 48 daily flights on the Braniff route, and raise to 17,000 the number of miles the airline flies daily.

KLM Royal Dutch, in South America, adds on August 15 a run from Curacao (Netherlands West Indies) to Kingston, Jamaica (British West Indies) giving this island fast connections to North and South America via KLM and the Pan American Airways System.

Penn-Central makes possible a constant fuel-air ratio for airplane engines by the development of a new carburetor air scoop by company's engineers.

United Air Lines is offering six optional routings on the double triangle of Salt Lake, San Francisco, Seattle and Los Angeles.

Canadian Colonial starts service for Glens Falls between New York and Montreal. It is enthusiastically received by the Saratoga race fans.

All American Aviation asked, July 30, an order fixing and determining a fair and reasonable rate for the transportation of mail over route No. 49.

Catalina Air Transport is granted by CAB extension of service from Avalon, Santa Catalina Island to Los Angeles, Calif., by way of Wilmington-Long Beach, California.

Eastern Air Lines asked, July 31, non-stop between Chicago, Ill. and Nashville, Tenn.

Chicago and Southern carries 41.27 percent more revenue passengers during first seven months of '41 than in same period of '40.

By Raymond Headley

Aircraft stocks have been the most active group on the stock market recently in recognition of their collective ability to show continued good earning power despite an ever-increasing tax burden. Steady earning power is resulting in liberal dividend payments in many instances this year. Furthermore all signs seem to point to a long war. The industry also still holds the spotlight in armament contract awards, upwards of two billion dollars in new orders having been received in the last two months. Meanwhile air travel in the United States attained new record levels for the fourth consecutive month in August, bringing the gain for the first eight months of 1941 to approximately 21 percent over the similar 1940 period.

Studebaker's chairman, H. S. Vance, is the first automobile official to give any inkling of that industry's long term plans respecting the manufacture of aircraft. Studebaker, which is tooling up to make Wright engines, regards this project as purely an emergency job and has no plans to continue this work in the post war period. However, Mr. Vance recently stated that he couldn't see the future clear enough to forecast whether or not other motor companies, now in aircraft on an emergency basis, might continue in that business in peacetime.

Dividend payments by aircraft manufacturing and associated companies are attracting lots of discussion in Wall Street these days as it is expected that there will be a number of large year end disbursements declared within the next month or two. After announcing an initial 70 cent payment in June, Cessna Aircraft declared another $1.25 a share dividend early in September. Thompson Products increased its third quarter dividend from the usual 50 cents to 75 cents.

Curtiss-Wright Corp. draws more speculation regarding dividend payments, perhaps because this company has more stockholders than any other aviation unit. As this was written there were rumors that Curtiss-Wright directors might give consideration to a year-end payment in the near future. Last November a dividend of 50 cents was declared and Wall Street will be disappointed if the payment isn't equally as large this year.

Fleetwings, Inc., maker of aircraft and parts at Bristol, Pa., is constructing a new plant to take care of a backlog of orders that now amounts to more than $20,000,000. There are 1,500 on the payroll and the company recently gained wide publicity for its offer to employ men who lose non-defense jobs.

Industry Backlog

Defense orders of the aircraft manufacturers now amount to approximately $7,650,000,000 in sharp contrast to the $2,000,000,000 unfilled orders of a year ago and the aircraft industry's backlog of only $300,000,000 in the fall of 1938. The government's total construction program calls for more than 75,000 planes (not all of which are yet on order) and aid to Russia may carry the total still higher.

Although defense authorities have revised downward the 2,700 monthly production goal originally set for December, 1941, they have accelerated the long term schedule and hope to attain a 50,000 annual output in the next nine months. That means the industry must double its current production rate of less than 2,000 defense planes a month by July, 1942.

One company only—Bell Aircraft Co.—is planning further plant expansion in the fighter plane category as the new emphasis is on heavy bombers—a type in which the British formerly showed little interest. Several large aircraft companies are pooling their productive resources to achieve an eventual output of 500 four-engine bombers a month. Two government-owned plants, operated by Douglas Aircraft Co. and Consolidated Aircraft Co., will start operations late in 1941 on Consolidated B-24s. Boeing Airplane Co., Douglas and the Vega Airplane Co. will produce the Boeing Flying Fortress in 1942. Ford Motor Co. also will start deliveries on the heavy Consolidated bomber by the middle of next year.

The following table gives the latest approximate backlogs of the defense aircraft producers:

Aviation Corp.	$15,000,000
Beech	90,000,000
Bell	158,000,000
Boeing	632,000,000
Brewster	115,000,000
Cessna	30,000,000
Consolidated	740,000,000
Continental Motors	30,000,000
Curtiss Wright	835,000,000
Douglas	620,000,000
Fairchild	22,000,000
Ford	787,000,000
General Motors	499,575,000
Grumman	70,000,000
Lockheed	853,500,000
Martin	638,000,000
Nash	45,000,000
North American	385,000,000
Northrop	95,000,000
Packard	167,000,000
Republic	88,000,000
Ryan	14,500,000
Studebaker	100,000,000
United Aircraft	480,000,000
Vega	120,000,000
Vultee	169,000,000
All others (Vendors)	525,000,000
	$7,634,575,000

Aircraft financing has been well received recently with the new stock often selling quite substantially above the marketing price within a few days after the issuing date. An offering of 100,000 shares of Bell Aircraft by New York bankers to secure funds for working capital was followed by the sale of 20,000 shares of Cessna Aircraft. Both blocks of stock met a quick response, indicating continued public interest in aircraft financing.

North American Aviation, in another type of financing venture, has arranged to purchase $3,000,000 of United States treasury notes. In this way the company is providing in advance to meet its 1941 federal tax obligations and at the same time make the funds immediately available to the government at a small interest rate.

Liberty Aircraft Products, in which Grumman Aircraft has a minority interest, has taken the initial steps to buy a big interest in The Autocar Company. Some 121,097 shares of Autocar common are involved or 30 percent of the outstanding stock. Grumman interests on the Liberty Aircraft board of directors voted against the proposed purchase. Both companies are operating at capacity with unfilled orders, combined, of over $50,000,000.

Solar Aircraft, San Diego, Cal., had sales of $300,000 in July and topped that figure by about 20 percent in August. Production is now running 73 percent higher than in the last half of 1940 and the company has a backlog of around $10,500,000.

Aviation Corp. fully owned subsidiaries have a comparatively small backlog of only about $15,000,000, but the parent company has large interests in Vultee (82 percent) and New York Shipbuilding which give it a stake in defense unfilled orders aggregating well over $700,000,000. Then too Aviation Corp. has a large holding in the stock of American Airlines.

Fairchild Aviation Corp. is understood to be negotiating new aerial camera orders which are expected to more than double

Current Earnings Reports

	Period	Net Profits 1941	Net Profits 1940	Profits per share 1941	Profits per share 1940	Sales 1941	Sales 1940
Boeing	6 mos. June 30	$2 011 380	L 286 174	$1 85	.	320 888 110	
Borg Warner	6 mos. June 30	4 007 544	2 830 083	1 71	1 21	—	—
Briggs Mfg	3 mos. June 30	2 397 318	1,945 187	1 16	0 93		
Cessna	6 mos. June 30	768 812		2 30		5 050 093	
Curtiss-Wright	6 mos. June 30	10 664 338	6 235 966	1 28	0 78	142 272 791	80 838 301
Douglas	6 mos. May 31	4 199 792	2 388 857	7 00	5 65	42 987 786	25 268 523
Grumman	6 mos. June 30	747 218	320 711	.	—	6 011 013	2 328 394
Murray Corp	6 mos. May 31	628 203	983 333	1 11	1 00		
Northwest Airlines	12 mos. June 30	327 465	206 409	1 36	1 27		
Sperry	6 mos. June 30	4 054 007	3 068 282	2 03	1 52	X 16 234 302	7 588 245
United Air Lines	3 mos. June 30	481 058	628 858	0 96	0 42	5 047 848	4 480 871
Wright Aero	6 mos. June 30	2 992 336	1 393 968	4 99	2 27	86 135 683	32 702 468

L—Net Loss. $—Before taxes. X—Gross income.

the company's current backlog of approximately $25,000,000. In addition Fairchild has certain other new products developed from research which may eventually rival the camera business in dollar volume.

Republic Aviation has completed deliveries against its second Air Corps' contract for P-43 pursuit planes by making the highest shipments in July and August of any two months' period in the corporation's history. Early in the current half year deliveries were running 306 percent ahead of the corresponding first quarter months.

Consolidated Aircraft proposes to declare a 100 percent common stock dividend this fall. This action is deemed desirable to effect a wider distribution of the company shares and to represent more adequately recent growth in size and volume of business. Stockholders met on September 18 to approve the program which will increase the amount of common stock outstanding from 645,787 to 1,291,574 shares.

Aircraft accessory firms of the Southern California area continue to report skyrocketing growth.

The Aerco Corp., through C. A. Herberts, pres., reports net profits of $44,333 for the fiscal year ended June 30th, last.

Aircraft Accessories Corp. reports the sale of 50,000 shares of preferred stock at $9 per share in connection with financing of a plant expansion program. Net billings for the fiscal year ended April 30 leaped to $684,761, more than 400 percent over the previous year.

Adel Precision Products Corp. of Burbank, shows August deliveries of $441,000, against July deliveries of $348,000, and $919,000 for the entire first quarter. Anticipated deliveries for the full year are expected to exceed $6,000,000, consisting chiefly of Adel four-way hydraulic selector valves, hand pumps, anti-icing equipment and line support blocks and clips.

Consolidated stockholders were scheduled to act late in September on a plan to increase the authorized capitalization 100 percent, from 1,200,000 shares to 2,400,000 shares, granting a 100 percent stock dividend to all stockholders. The amendment also would eliminate the remainder of the authorized preferred stock. There are now but 645,787 shares of common stock outstanding. Increase in number of shares was calculated to represent the company's recent growth, and effect wider stock distribution.

Raw Material Shortages

Russia wants to purchase aluminum from the United States. This unexpected new demand on our scanty resources of the white metal, so vital to aircraft manufacture, will tighten further the aluminum situation whereby supply now just about equals defense and lease-lend requirements. Already the O.P.M. has made arrangements to send 2,500,000 pounds to the Soviet. It seems that destruction of the great Dnieprostroi Dam wiped out Russia's principal aluminum supply of 75,000,000 pounds a year. The Leningrad plant of 30,000,000 pounds capacity also is out of operation. Only a 50,000,000 pound plant in the Ural Mountains remains intact and it will be another year before capacity of this unit can be doubled.

Priority preference on scarce materials has been granted a group of light plane manufacturers, engine makers and producers of light plane radio equipment, provided these materials are used for defense or defense-related purposes. That means 7,000 or 8,000 light planes will be produced during the next twelve months according to the Aeronautical Chamber of Commerce estimates. This will compare with an output of 6,583 light planes in 1940 and 3,773 in the first half of 1941. Re-engineered in recent months to dispense with as much critical material as possible, as many as 30,000 planes would require less than 8,000,000 pounds of aluminum, nearly all of it from secondary metal sources.

The nationwide pots and pans collection campaign, fostered by the LaGuardia civilian defense agency, proved highly disappointing to defense officials. Preliminary estimates place the collection totals at less than 14,000,000 pounds—more than 1,000,000 pounds under the minimum goal.

Meanwhile the Aluminum Co. of America has reduced the price of aluminum from 17 to 15 cents a pound, bringing it down to the lowest price on record. Fifty years ago when Alcoa first began operations its 9,000 pound annual output sold at $8 a pound. Alcoa now produces 700,000,000 pounds a year and new expansion about to be undertaken will bring the company's total up to 1,100,000,000 pounds. All domestic companies will have a total output of 1,500,000 pounds by the middle of 1942, as against 450,000,000 pounds in 1940.

Economic Warfare in Latin America

By Raymond Hoadley

The United States is waging economic warfare in dead earnest—principally by advancing this country's leadership on the former Nazi skyways over South America. So far all but one of the Axis airlines have been eliminated from western South America and efforts are now concentrated on removing the last vestiges of Nazi influence from all other air routes south of the Rio Grande.

The agency entrusted with rooting out these powerful German aviation ties with our southern neighbors is the American Republics Aviation Division of Defense Supplies Corporation. The division is staffed with a number of top-flight aviation and financial experts including William Barclay Harding, Thomas O. Hardin, William A. B. Burden and Reed Chambers. Sam Husbands and Will Clayton, aides of Federal Loan Administrator Jesse Jones, have general supervision over the aviation angle of economic warfare activities.

So much for the agency itself, here's what they have accomplished since last spring. A mission made up of Tom Hardin, Franklin Field, a director of Piper Aircraft and partner in the New York brokerage firm of J. E. Swann & Co., and Allen W. Dulles, from the law firm of Sullivan & Cromwell, was sent to Bolivia. After six weeks of successful negotiation with government officials there, Bolivia expropriated the 50 percent German Junkers interest in Lloyd Aereo Boliviano.

Part of the Lloyd line was assigned to Pan American Airways' subsidiary, Panagra, thus making possible the first coast-to-coast crossing from Brazil to Chile under American management and by American planes. The rest of the line has been nationalized and will be managed by Panagra under a five year contract.

Under the agreement negotiated by the mission Bolivia agrees: first, to make no airline concessions to European countries for five years; second, to employ only citizens of the Americas in technical positions and third, to buy all transport equipment from the Americas. The Bolivian government also has granted a subsidy of $18,000 a month to the new nationalized line.

In turn, Bolivia has been granted a loan of $600,000 from the Federal Loan Administration, $300,000 to be used for airline working capital and the rest in payment for three Lockheed Lodestar transport planes which the mission obtained from the War Department. Three Junkers planes which the mission took over probably will be used for targets up here.

Another indirect result of this mission's activities south of the border is the recent decision by Ecuador to suspend operations of the German-controlled Sedta (Ecuadorian Aerial Transport Service) air line and to grant exclusive Ecuadorian air route rights to Pan American Grace Airways.

Peru has grounded the Lufthansa of that country and it is hoped that one big line may be evolved out of the suspended Nazi line and the other American line in operation there. J. Parker Van Zandt from the Civil Aeronautics Board is representing the American Republics Aviation agency in Peru while Stokes Morgan has charge of activities in Ecuador.

As an indication of the success achieved in the program to supplant European-sponsored air services, the following tables compare United States and German airline mileage figures for western South America two years ago and today:

	German controlled or influenced		United States operated or sponsored	
	Oct. 1939	Oct. 1941	Oct. 1939	Oct. 1941
Bolivia	4,109	0	795	4,904
Colombia	5,494	0	1,274	6,769
Ecuador	590	0	363	953
Peru	1,210	0	1,256	1,256
Chile	0	0	1,176	1,176
Trans Andean (Chile Argentina)	870	870	870	870
TOTALS	12,273	870	5,734	15,928

(Turn to page 135)

(Continued from page 132)

Frank F Russell, president of National Aviation Corporation heads a mission to Brazil where there has been talk for some time about a government plan to take over the Condor Air Lines—a subsidiary of Lufthansa In the remodeling scheme Panair would don the managerial mantle cooperating with the Brazilian government. Ward Pierson, president of the Export-Import Bank is also in Brazil, presumably in connection with the policy of Pan-Americanization of Brazil's air-lines Good neighbor relations between the United States and Argentina are getting progressively better and it is understood that a similar air mission will be sent to the latter country.

Republic Aviation Corp has under construction at Farmingdale, N Y, a 45,000 sq ft. office building which will house all of its administrative activities The building, to be constructed of brick, steel and glass, is rising on the northern side of the new Republic assembly plant Cost of the building and equipment, provided under a U. S Government Facilities Agreement, is approximately $300,000 Includes air conditioning, fluorescent lighting, and is designed with blackout provisions

North American Aviation Inc, has leased an additional 5.35 acres of land on Los Angeles Airport as a site for immediate erection of an $800,000 addition to the parent plant, now employing about 12,000 workers

Menasco Manufacturing Corporation is expanding facilities of its hydraulic strut manufacturing division through a $1,638,058 Defense Plant loan to provide 160,000 sq ft of floor space Backlog of the Menasco strut division alone is reported at more than $4,000,000, with substantial manufacturing operations also under way in the engine department, supplying training plane engines to Canada, China, the Dutch East Indies.

Calling for the production of thousands of aircraft engine exhaust systems of the patented Ryan ball and socket joint type the Ryan Aeronautical Company reports receipt of a $2,000,000 (approx) manifold order

In line with present aircraft industry wage stabilization efforts, Ryan has signed a contract with the United Aircraft Welders, an independent union calling for a wage increase to a 75 cents per hour minimum after 12 weeks' experience.

NARUC Recommends that Power Lines Be Removed

A recommendation that the states require public utility companies to remove at their own expense any dangerous hazards to airports—such as telephone, telegraph and power lines—was adopted by the recent convention of the powerful National Association of Railroad and Utility Commissioners, meeting in St Paul, Minn

Action followed a vigorous plea by CAB member Oswald Ryan, an honorary member of the association, who emphasized that public safety demanded the elimination of such obstructions.

Mr. Ryan called attention to the pioneering efforts of the Public Utilities Commission of Pennsylvania, which has already required removal of public utility hazards at five airports.

At first the association had contemplated recommendation that the states enact laws establishing state regulation of intra state transportation, but this suggestion was dropped from the final report.

Consolidated Aircraft Corporation has been going through a hiring "splurge" believed unequalled by any other plant in the country For more than six weeks, well into September, new workers have been employed at the rate of more than 1,000 a week and, according to C. H Batchelder, "the end is not in sight." Chief reason for the present hiring spree is the start of parts manufacturing operations in the huge new Consolidated fabricating plant now nearing completion. More than 25,000 men are now in Consolidated's employ and new workers have been pouring in from out of the state, especially from Oklahoma and Texas. By mid 1942 the payroll is expected to top 42,000, including several hundred women, as production reaches a peak in working off the present $750,000,000 backlog. About thirty women had been hired by mid-September, and hundreds were to be hired all the wives or close relatives of male employees It is felt that hiring women relatives of men already at work in the plant will help to stabilize the domestic planning of the women involved

HUGE SIGNBOARDS like this erected at its new aviation plant at Melrose Park outside Chicago tell Buick's defense story to the public Engine is P & W's Twin Wasp

Fred Loomis

FIRST sailplane to be delivered to the Navy It is a 2-place Schweizer model built to Navy specifications at Elmira, N. Y.

DUMBOMBERS for defense, first unit off the production line, in a test run at Walt Disney's Hollywood factory, shows the rounded contours of the latest creation for hemispheric defense

Glider Order

A substantial Army order for two-place training gliders is reported pending Various companies are known to be submitting two-place gliders to the Army for study. One such design, now under development by the Bowlus Sailplanes, Inc, of San Fernando, Calif., carries pilot and instructor in tandem in a mid-wing cantilever monoplane of wood construction which is expected to be a definite advance over any glider training equipment previously available Plane are being studied for complete instrument and radio installations, including two-way voice communication and oxygen apparatus for both pilots No official announcement has been made by Bowlus or Army officials, but studies are also believed under way on other applications of gliding and soaring to military operations

Francis Galligan Dies

It was with deep regret that we received the news of the death, on Sept 1, of Francis A Galligan, vice president and general manager of Fairchild Aircraft Division of Fairchild Engine & Airplane Corp Mr Galligan learned to fly on the West Coast in the Air Corps during the first World War Later he became western district sales manager for Curtiss-Wright, then joined the Fairchild organization in 1932 He moved to Hagerstown in 1936 and became vice president and general manager the following year Only 45 years old at his death, Mr Galligan is survived by his widow and a daughter.

OPERATORS CORNER

Mechanics Wanted

Big problem of aviation schools a few short months ago was to find jobs for its mechanics. Now the situation is reversed and large schools doing flight training jobs for CPTP or the Air Corps are looking for certified mechanics with A and E licenses.

Typical of this situation are two busy organizations in Southern California, Major C. C. Moseley's schools and the Ryan School. Under the various Moseley banners some 175 training planes are being flown daily. Training planes are bumped around and given rough handling, and a fleet this size calls for a lot of maintenance. Under the direction of Chief Kidder, extensive maintenance shops are kept operating on a 24-hour basis. The problem of getting skilled men for line inspections and for overhaul work is difficult to solve.

The Ryan flight schools operate well over 125 airplanes. Technical Director Walter Balch has long since used up the supply of experienced airplane and engine mechanics in his area. He is having increasing difficulties in getting men with sound maintenance training or experience.

Civil Service Jobs

Civil Service jobs with the Federal government that pay $2,000 as a beginning wage are open to men who have had four years of college engineering training with either a major in aeronautical engineering or ten semester hours of credit in aeronautical engineering, or its equivalent in national defense training courses. Details may be secured from any post office or from the Civil Service Commission in Washington, D. C.

New Embry-Riddle Course

"Airfax", a new aviation course, has been added to the Embry-Riddle School of Aviation technical school curriculum, at Miami, Florida.

The new course, the second unique step in aviation instruction to be announced recently by the Riddle school, comprises a 48-hour, eight weeks survey of aviation for the benefit of new and inexperienced aircraft employees who need greater familiarity with aviation terminology, nomenclature and traditions.

Emmitt B. Varney, director of industrial relations for Intercontinent Aircraft Corp., has been appointed assistant to President John P. Riddle of the Embry-Riddle School in Miami.

One-hour lectures, motion pictures and other illustrative material from both shop and hangar, together with a brief demonstration flight for study of controls and instruments, comprise the course.

Embry-Riddle previously announced a dual language program whereby Latin-American students could learn aircraft work in either Spanish or Portuguese, and United States workers, desiring to pursue an aircraft career in South America, could study their course in the language of the country to which they were going. Both courses are unique in American aviation schools.

Roosevelt School

Starting its fall classes on September 29, the Roosevelt Aviation School at Mineola, N. Y. began its new year with considerable new equipment and an expanded staff of instructors. The school reports that many of its new students realize that basic mechanical training covering a year or more of work is the best investment for future security. In every section of the country there is a shortage of men who are qualified to do maintenance work on airplanes and engines.

Like father like son is the formula being followed by Edwin Marriott, 16-yr old son of Lt. Col. Joseph S. Marriott, Regional Manager for the C.A.A. in the Calif., Ariz., Utah and Nevada area. Marriott, who has 700 employees under his jurisdiction, is also commanding officer of the local Army Reserve Squadron. Yet he has found time to give dual instruction to his son Edwin, in an Interstate Cadet trainer, and on Edwin's 16th birthday, Papa Joe authorized a solo flight by son Edwin. Edwin, now working for Alvin C. Eager, CPTP operator, is literally following in his father's propwash.

Purchase of the controlling interest in the Westwood School of Aeronautics is reported by the Ryan Aeronautical Company. Westwood has been reorganized and will be operated in future under the name of Ryan Aeronautical Institute, according to T. Claude Ryan. The Westwood School, specializing in home study engineering courses, was founded by Gordon D. Brown, domestic sales manager of the Douglas Aircraft Company. Present high standards of texts and supervised courses of study will be maintained under the personal direction of Ban Robison, formerly vice president of the Westwood School, and now named vice president in charge of sales of the Ryan Aeronautical Institute.

Ban Robison, new vice president and sales manager for the Ryan Aeronautical Institute, which was formed to take over the former Westwood School of Aeronautics in San Diego, Calif.

Airport problems of the Southern California area have been intensified by the mounting military operations plus delivery and test flights of military equipment manufactured in that area. The city of Los Angeles has now completed purchase of the Los Angeles Airport, formerly leased, and construction of facilities is being rushed so that all airline operations may be moved to Los Angeles Airport from Lockheed Air Terminal. Under the present Federal airport control scheme the entire Southern California area will soon be brought under rigid traffic control. At present all ferry flight activities are being controlled from the huge Long Beach airport, where a runway system and new airport terminal buildings are nearing completion, with the runways already in use.

Further relief is being sought through provision of a new Los Angeles County airport some distance from the congested area, probably in the Antelope Valley about 60 miles north of Los Angeles.

More Training for British

Embry-Riddle opened a new $500,000 all-British flight training center on September 15 at Clewiston, Fla., last month. It is operated directly with the British rather than through the U. S. Air Corps. Instruction is given in primary, basic and advanced flying. When the new school was opened students were shifted over from the Embry-Riddle school at Arcadia, Fla.

When the Riddle Aeronautical Institute at Arcadia turned out its first graduating class in August, Group Captain D. V. Carnegie, who directs all British flight training in this country, was present to address the graduating class. He gave high praise to the training methods used at the school. With graduation of that class, Carlstrom Field became an all-British center, as U. S. Pilots were shifted to nearby Dorr Field.

Major C. C. Moseley, president of Curtiss-Wright Technical Institute, Glendale, reports a sharp increase in enrollments for the long-term career courses in aeronautical engineering and aviation mechanics. This reflects the fallacy of the short-term training course, as well as the growing realization of the greatly increased need for competent trained aircraft mechanics and engineers. Major Moseley is at present urging a Civilian Mechanics Training Program, sponsored by the Federal government as was the CPTP in order to provide such training for ambitious boys who are short of money. He reports having on file the names of more than 100,000 boys who want such training but who cannot afford to pay for it.

Recent Books

Mechanical Engineers' Handbook, *edited by Lionel S Marks* Published by McGraw-Hill Book Company, New York, N Y, 2,274 pages, illustrated, $7 00

Marks' Handbook endeavors to present both fundamental theory and the data of experiment and experience throughout the range of subjects falling within the province of the mechanical engineer During the eleven years which have elapsed since publication of the previous edition great advances have occurred in practice and in theory Hence, the 1941 edition is not merely a revision, but has been largely rewritten to incorporate the mass of new knowledge and data.

Among the new subjects covered are the theory of models, plastic behavior of materials, stress concentration, creep, packings, wind pressure on structures sound and noise, automatic control of processes and powder metallurgy Altogether about 100 engineers and scientists all selected for their special competence in particular fields, worked on the production of this handbook

Although intended primarily for students and practicing engineers, the subject matter is so presented as to be of value to mechanically-minded intelligent laymen as well

Aircraft Engines Volume II *By A W Judge* Published by D Van Nostrand Company, Inc, New York, N Y, 466 pages, 354 illustrations $9 00

The first volume of this work, published earlier this year, was concerned mainly with the theoretical and experimental aspects of aircraft engines, whereas the present volume is devoted principally to the descriptive side of the subject

Although descriptions of most American aircraft engines are included, engineers and students in the U S will find particularly interesting the detailed descriptions, cutaway and sectional views and detail drawings of standard British engines It is regrettable that the author could not treat of most recent developments such as the Rolls Royce 2000 h p "Vulture" and the Napier 24-cylinder "Sabre" engines However, some of the conjectural discussions anticipate these developments.

Aircraft Instruments, *by George Ellis Irvin.* Published by McGraw-Hill Book Company, New York, N Y, 506 pages, 545 illustrations, $5 00

This book incorporates in a single volume all of the information required for a complete course in modern aircraft instruments A chapter on meteorology is included to provide the background knowledge necessary to understand the purpose and functioning of meteorological instruments. In every instance the author has attempted to describe those components of the aircraft which are related in any way to the instrument in sufficient detail to enable the student to coordinate his knowledge of a particular instrument with the operation of the aircraft in its entirety

The text deals successively with all modern types of meteorological instruments, engine instruments, navigation instruments and flight instruments. Furthermore, Mr Irvin has accompanied the descriptions of various types of instruments with complete instructions, including step-by-step illustrations, for tear-down, assembly, inspection, adjustment and maintenance

The volume was prepared especially for use as a textbook for instrument courses in technical high schools and aircraft schools, operators and manufacturers To the end that it will achieve the widest usefulness in these fields the subject matter has been clearly presented in the simplest language possible. The book also should find valuable applications in maintenance shops by virtue of those portions of the text treating of installation and repair procedures

Aircraft Template Development, edited and published by Aero Publishers, Inc., 120 N Central Ave, Glendale, Cal 312 pages, $4

This is an excellent book and is based on practices being used in a dozen or more of the large aircraft plants. It fills a definite place in aviation literature The text covers factory nomenclature, mathematics, elementary drafting, engineering drafting, principles of mathematical development, tools and equipment used in template making, typical parts and their flat pattern development, photographic methods plus various charts and tables The book is well illustrated with drawings photographs and blueprints.

Light Aircraft Performance Calculation, *by Juan K Serralles,* Aeronautical Engineer Published by Aviation Press, San Francisco, Calif 67 pages

This 67-page booklet should serve a most useful purpose for aviation students who want clear, concise instruction on lightplane performance calculation Unencumbered by excess verbiage, it begins with fundamental design characteristics which determine aircraft performance Eighteen charts and eight tables illustrate the text. The author has also written a book on aerodynamics in Spanish, the first in that language

Aviation From Shop to Sky, *By John J Floherty* Published by J B Lippincott Company, New York, N Y, 215 pages, 90 illustrations, $2 00

Frankly admitting to his readers that he is neither aviator nor engineer, Mr Floherty wins their confidence by explaining that he approached his task "as a reporter on a major assignment"

It is a nontechnical book, written in a free, swift-moving style which should quickly capture and hold the interest of aviation enthusiasts, young and old, who are eager to advance their knowledge and understanding of flying

The author describes what is happening in the fields of aircraft and engine manufacturing, air transportation, pilot training and mechanic and worker instruction A considerable portion of the book is devoted to military aviation and the text throughout is accompanied by excellent photographic illustrations

The New Army of the United States, issued by the Bureau of Public Relations, War Department, Washington, D C 141 pages, paper cover

This is a comprehensive report on the state of the Army of the United States as of August 1, 1941 It traces briefly the transition of the small, skeletonized U S Army to an expanding organization which must be transformed into a fully-equipped modern fighting force of seasoned and trained soldiers

The document then describes the organization and the missions, methods and equipment of the various components of the new Army The report is full of straightforward factual information and should prove of great value to writers, editors and commentators whose duties require some knowledge of the fundamentals of our modern fighting machinery

Aircraft and Power Plant Accessory Equipment, *by Sidney H Webster* 151 pages, $2 Published by the National Aeronautics Council, NYC

The author is an engineer in the Eclipse Aviation Div of Bendix He has written the only book we know of dealing exclusively with accessory equipment The text covers such important subjects as engine accessories, generating equipment, starter accessories, vacuum instrument pumps, hydraulic equipment, ice elimination equipment, fuel flow meters and other miscellaneous devices The book is clearly written and is well illustrated

(*Additional reviews appear on p* 152)

Brewster

(Continued from page 75)

furnace records are always available should any question arise

The 24S parts are put directly into the salt bath, either by placing them in a basket, or by suspending them by means of wires, and are held at the critical soaking temperature (910 to 930 deg F.) generally for a half hour, depending on the thickness of the metal At the end of the soaking time, the parts are immediately quenched in cold water which must not be over 80 deg. F or age hardening would be hastened If the heat treatment has distorted the parts, they are immediately placed in a refrigerator, since the lower temperature, after quenching, retards hardening The parts then can be reworked and corrected and left to age harden

For protection, all pre-sub-assembled parts are put through the anodizing process—a half-hour dip in tanks of chromic acid, through which an electric current is run, followed by a rinse in hot water—and then painted Great care is taken to prevent scratches on the metal which would ultimately lead to structural failures.

Spars, Ribs and Bulkheads

The fabricated parts received from the Sheet Metal Department move to Department B where they are assembled into troughs, spars, leading edge ribs and wing bulkheads

In assembling the four main spars,

Upright jigs and overhead racks save space and relieve working conditions in wing bulkhead section.

Water-testing a wing float brace. Floats and braces must be absolutely water-tight before they are passed.

In the Covering Dept., Veronica Coskey (standing) and an assistant stitch Grade A cotton fabric on aileron with curved needles. The curved-type needle makes rib stitching much simpler than with the straight-needle type.

front and rear, for the left and right wings, a new riveting method developed by a foreman consists of several rivet guns running freely on an overhead track which allows several men to work at the same time on a spar As a result, spar production has been tripled by a method simpler and easier in every way than the old, heavy single-press method.

Nose rib section production has also been increased tremendously by use of rows of upright jigs mounted on a six-inch pipe and workable from two sides This method, which saves both time and space, results in more accurate work as the parts cannot move and, being assembled together on one jig, are exact in size. The same practice is used in assembling bulkheads, which when finished are temporarily stored on overhead racks to conserve space

While the spars, ribs and wing bulkheads are being assembled in Department B, Departments C and D are at work on trailing edges and ailerons, wing floats and braces After assembly, the trailing edges and ailerons are sent from Department C to the Covering section in the Finishing Department to be covered with fabric.

The floats and braces, parts for which have been fabricated in the Sheet Metal Department, are thoroughly water-tested by a special crew which fills each float and brace with water Until absolutely water-tight no float or brace is passed to the Final Wing Assembly where all sub-assemblies from the various departments finally meet.

Final Wing Assembly

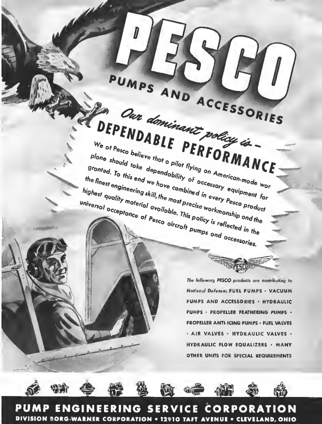
One of the most Interesting and novel means of stepping up final wing assembly production is the use to which Brewster has put its diminutive men, little in size, but big in their contribution

After spars, bulkheads and troughs are put in place, sheets of skin 025 inch thick are placed on the upper and lower sides of the wing, being held in place by "cleco" buttons before riveting For this job, wing interiors are not the roomiest of places in which to carry out constructional activities, even in the Consolidated wing, but the problem was neatly solved by the fortuitous presence of "Johnny Gee" Unlike his more cumbersome fellows, Johnny could move with comparative ease inside the wing, and so has become well-nigh indispensable as a bucker in skin-riveting jobs So well has Johnny Gee turned out, that Brewster now has six more men of similar small size, and thereby has doubled production on several jobs in final wing assembly

In the Covering department, to which ailerons and trailing edges are sent to be covered with Grade A cotton fabric, are employed the only girls in the factory. One of the women in this department, Veronica Coskey, is a veteran aircraft fabric worker who did her first stitching on airplanes for Anthony Fokker in 1925 The women hand-stitch the covering to the trailing edges, cut-outs and ailerons

To facilitate rib-stitching, the use of a curved needle has proven greatly superior to the straight type in getting be-

(Turn to next page)



hand and around the rib in sewing fabric on aileron structures This innovation, simple as it seems, has added considerably to increased production

When the work is completed in the Covering department, the finished products are sent to the dope room where several coatings of dope are applied with hand brushes and spraying. These cloth covered parts and the finished wing panels, floats and braces are finally painted in this last department insignia are painted on, and Consolidated Aircraft takes delivery on one of the biggest long-distance sub-contracting jobs in the country

Little men are used to crawl into the Consolidated wing interior in Final Wing Assembly Here "Johnny Gee" works as bufer in skin riveting job Space at wing tips is limited to about one foot.

General view of Final Wing Assembly Spars, bulkheads and troughs are put in place, after which skin is riveted.

Surface Preparation

(Continued from page 83)

channels bolted together were exposed to the weather at an angle of 45 deg. to the vertical, facing south, at a point about 300 ft. from the seashore. Each channel was completely painted before assembly. Thus some of the surfaces were exposed to sunlight while others were completely shaded.

An apparatus was constructed at Aluminum Research Laboratories at New Kensington, Pa., alternately immersing specimens in salt water. The tank is located out of doors and the test pieces are alternately wetted by salt water and exposed to drying and sunlight. They are mounted on a rack, at an angle of 45 deg. to the vertical, facing south; the entire rack is lowered into the salt water and raised again by means of a motor and a special train of gears. The motor is actuated by an electric time clock, so that the specimens are immersed for five minutes out of every thirty minutes. In this test, simple panel specimens are usually employed.

In addition to the accelerated exposure tests by salt water immersion at New Kensington, atmospheric exposure tests are also conducted on the roof of the Laboratories. Here again, the panels are mounted on racks at an angle of 45 deg. to the vertical, facing south. The panels used for these tests are 8 x 24 in. in size and are made from 14 gage metal.

Recently a new type of tidewater test has been carried out. This test is conducted in rapidly flowing sea water near Wilmington, N. C. A special rack made of aluminum was constructed for supporting the panels. The rack is rigidly supported above the canal through which the sea water flows. While the lower portion of each panel is continuously immersed, the central portion is subjected to splash and spray at the water line, and the top area is exposed to the air. This test has been found to be particularly effective in evaluating methods of surface preparation prior to painting.

Test Results

Tests of painted aircraft castings have been conducted in salt spray tanks at Cleveland, Ohio. The specimens used in this test consisted of sand cast panels four in. by six in. by ¼ in. thick, and were suspended vertically in a tank filled with salt mist. The temperature of the salt solution atmosphere and the purity and concentration of the salt solution are closely controlled to insure reproducible results.

In all of these tests, two types of surface treatment were found to be outstanding in performance. These were the coatings produced by anodic oxidation and coatings produced by certain chemical treatments. The latter comprises oxidation by immersion in a hot solution of sodium carbonate and potassium dichromate for about ten to twenty minutes, followed by a sealing treatment in hot five percent potassium dichromate solution. These treatments are designed as "Alrok"* procedure No. 12 for wrought alloys and No. 714 for cast alloys.[7] Of the various anodic coatings, "Alumilite"[3] treatment No. 205 appears to be among the best in the case of the wrought alloys and No. 710 in the case of cast alloys.[3, 8, 9] For purposes of simplification, therefore, the comparison will, in most cases, be drawn between these two treatments.

In one series of tests conducted in the Edgewater alternate immersion equipment, two boxes of 17S-T alloy were included which were prepared for painting by means of an Alrok treatment and Alumilite treatment and then given a coat of quick-drying zinc chromate primer and one coat of aluminum paint made with a phenolic resin varnish. These boxes, shown in Figure 1, were exposed for five summer seasons of about six months each and received 24,275 cycles of immersion. Neither box showed serious paint failure after this exposure, although the box which had received the Alrok coating showed a few small corrosion pits at the water line, on three sides, with considerable corrosion in three of the joints inside the box. The box which had received the Alumilite treatment showed no failure on the outside, aside from moderate edge attack which was also noted on the Alrok-treated box, but on the inside showed slight to moderate corrosion in the joints. The paint on either box would be considered to have given very good service.

In the atmospheric exposure tests conducted along the seacoast at Point Judith, R. I., two box girders constructed of 17S-T rolled channels bolted together, were given the Alrok treatment and the Alumilite treatment, respectively. A third box girder was treated with a phosphoric acid solution for comparison. To all sections were then applied three coats of aluminum paint made with a spar varnish vehicle. The sections treated with phosphoric acid solution began to show corrosion blistering after about 18 months' exposure, although this did not become serious until after five years' exposure. The sections given the Alrok treatment showed a few small corrosion blisters, mostly near the edges, after about three years' exposure, which did not become appreciably larger after five years' exposure. The Alumilite-treated girder gave similar results, although after five years' exposure the blisters were perhaps more scattered than on the sections treated by means of the Alrok process. Both girders were still in good condition.

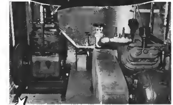
A large number of sheet panels have been exposed in the outdoor salt water alternate immersion tank at New Kensington, Pa. In one group of panels various methods of surface preparation of 17S-T prior to painting were compared. Included in this group were panels, some of which had been given the Alrok treatment and some an Alumilite treatment. The panels were painted with one coat of the well known P27b type of zinc chromate primer and one coat of aluminum paint made with a 33-gallon phenolic resin varnish. The paint on both these panels was intact after 573 days' exposure in the alternate immersion tank, which included 27,271 cycles of immersion. A similar panel which had been treated in a phosphoric acid solution prior to painting was beginning to show slight signs of failure, while panels which had been given several other types of chemical treatment had shown considerable paint peeling after 322 days and were removed from the experimental test at that time.

In the atmospheric exposure tests at New Kensington, 17S-T panels which had been given Alrok and Alumilite treatments, followed by two coats of aluminum paint, were still in very good condition after eight years' exposure. The paint films were still intact on both panels, although they were somewhat discolored on the backs. A panel which had been solvent-cleaned began to show slight failure by peeling after three years' exposure, this condition gradually became more severe until, after seven years' exposure, this panel was in poor condition. Treatment in phosphoric acid solution proved somewhat more effective though it was decidedly inferior to an Alrok treatment as a base for painting.

A recent examination of panels exposed in the tidewater test at Wilmington, N. C., gave further proof of the value of Alumilite and Alrok treatments for preparing aluminum alloy surfaces for painting. The panels in this test consisted of two heavy plates of 53S-T, held together by means of a cover plate of the same material, which was held in place with large 53S-T rivets. One of the plates was given an Alumilite treatment and the other plate was treated by means of the Alrok process. The entire as-

(Turn to page 146)

* Alrok is a registered trademark used to identify coating processes patented by Aluminum Company of America.



Surface Preparation

(*Continued from page* 144)

sembly was primed with an iron oxide-zinc chromate primer made with a phenolic resin varnish, the lower half, which was continuously submerged, was finished with a special antifouling paint and the upper half was finished with two coats of aluminum paint made with a varnish similar to that used in the primer. The group in which this panel was included was exposed from July 7th, 1937, till May 16th, 1940, a period of about 2¾ years. The primer was intact and still giving protection on all surfaces of this panel after this exposure. The top coats above the water line were also intact, but below the water line the top coats were nearly gone on the area which had received the Alrok treatment and were but slightly better on the area having the Alumilite treatment. This panel is shown in Fig. 2.

Sand cast panels of 195-T4, 355-T4, and 356-T4 alloys, given Alrok and Alumilite coatings and subsequently coated with phenolic resin varnish, were subjected to salt spray tests at Cleveland. A third series of cast panels was merely cleaned with an organic solvent prior to painting. The cast alloy panels which were merely solvent-cleaned showed early failure by paint peeling with subsequent corrosive attack of the metal. The castings which had been given the Alumilite or Alrok treatments prior to coating survived an exposure period ten times longer without failure.

Conclusions

From these tests it is apparent that paint adherence with severe wetting and drying is almost as good on aluminum alloy surfaces treated by means of the Alrok process as on surfaces given an Alumilite treatment. For many types of exposure, practically no choice is found between these two methods. Even under severe conditions of test, the results secured with Alrok treatment were very satisfactory. It should therefore prove an adequate treatment prior to painting for aluminum alloy surfaces used in aircraft and aircraft engines, with the possible exception of pontoons and the bottoms of flying boats.

References

[1] Bengston, H.—U.S. Patents 1,869,041-2, Gower, C.H.R.—U.S. Patent 1,869,058 (July 26, 1932).
[2] Edwards, J. D.—U.S. Patent 1,946,152 (Feb. 6, 1934).
[3] Edwards, J. D.—The Monthly Review American Electroplaters Society 26, 513, (1939).
[4] Edwards, J. D. and R. I. Wray. Ind. Eng. Chem. 27, 1145 (1935).
[5] Ibid.—Anal. Ed. 7, 5 (1935).

Loop Navigation

(Continued from page 55)

while simultaneously rotating the loop. This is particularly true in rough air or when the loop azimuth crank is inconveniently located. Another theoretical disadvantage is that the distance is increased from the station as the problem is worked.

While the basic scheme of the orientation procedure outlined above is quite simple, its execution in practice is considerably improved by attention to details of technique. For example, when tuning in the station preparatory to executing the orientation, use the standard antenna for tuning purposes and then switch to the loop. If a loop amplifier is in the circuit, this must also be tuned to the correct frequency before trying to obtain a null.

Though it makes no real difference in which direction the turn is made in order to pick up the null on the wing tips, it is good practice to choose the direction requiring the least amount of turn. Practice will make this easy to visualize after obtaining the original null on the station. A rule might be to note which wing tip is nearest to the rearmost null pointer and turn in that direction.

Another suggestion is to make this turn of standard rate—3 deg per second—in order to minimize the possibility of missing the null signal during the turn. Also, use only a moderate volume while this turn is being made so that the null will be wide enough to guarantee its being recognized. After the turn is stopped, the null width should be cut to approximately 3 deg.

The time interval needed to obtain a positive pointer change after attaining the wing tip null position depends directly upon the airplane's speed and distance from the station. A minimum of 10 deg pointer change should be considered reliable. Do not become over impatient to get results.

Loop Orientation—Heading Progression Method

An alternative method of loop orientation is illustrated by Fig 3. Assume positions 1 and 4 furnish the same problem of orientation as given for the previous procedure, that is, the line of bearing illustrated is ambiguous since the general direction of the station is unknown. To eliminate this ambiguity, proceed in the following manner.

1. Rotate the loop until the null position is aligned with the airplane's lateral axis. The pointer will read 90-270.

2. Make a turn to either right or left until the null signal is received. This momentarily places the airplane exactly broadside to the station as shown in positions 2 and 5. Note the heading.

3. Adjust the volume control so that the null width is approximately 3 deg.

4. As soon as the airplane's forward movement has caused loss of the null signal, make a few degrees of turn to the left or right as required to regain it. It is important that this turn be made immediately the null is lost so that only a few degrees need be made to regain it. By acting promptly it will be readily apparent if a turn is started the wrong way.

5. Continue to hold this null signal by turning the airplane as required, but *do not move the loop position from the wing tips.*

6. When sufficient change of airplane's heading has been noted to positively determine in which direction it is necessary to turn to hold the null signal, the station direction is established.

7. If the turn has been made to the right as indicated by the change in heading, the station is to the right, as at position 3 in the figure. If a turn has been made to the left, the station is to the left, as at position 6.

This procedure is fairly simple to execute in a small airplane or when one pilot is forced to fly the airplane and handle the loop also. It will be apparent that once the loop null position has been rotated to the wing tips, no more attention need be given it. The disadvantage of excessive maneuvering makes it less desirable than the previous method for use with a large airplane.

The items of technique, such as station tuning, direction of first turn, and handling of volume control, mentioned in connection with proper execution of the pointer progression methods, likewise apply to this method.

Ascertaining Course to the Station

At the completion of each of the two loop orientation procedures just outlined, the general direction of the station from the airplane is established. While this is the most vital item of information required, a little thought applied to the problem at this point will furnish important supplementary information enabling a pilot to conduct subsequent navigation with intelligence and complete satisfaction.

A careful pilot will not be satisfied with general direction to the station after orientation, but will want the exact direction. This is very easily obtained.

Referring to Fig 4, Case A illustrates one method. Simply rotate the loop so that the null position is aligned with the airplane's longitudinal axis and turn toward the station until a null signal is received as at position 4. The null pointer will read 0-180 and as long as the null is being received in this position, the airplane is pointed directly at the station. The directional gyro will indicate the magnetic *course* to the station at that instant—in this example—340 deg. Note that *course* and *not heading* is obtained. It is necessary to compensate for the effect of wind drift in order to obtain the heading to fly to make good this course. This will be discussed in a following paragraph under "homing" methods.

Another method is to obtain the course to the station after orientation by computation. At the moment of establishing the general direction of the station from the airplane, note the gyro

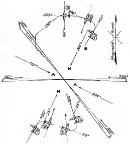


Figure 4
Radio Range Technique

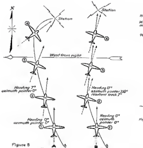


Figure 5
Homing

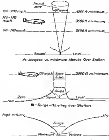


Figure 6

heading. Then simply add or subtract as required from this figure the angle which the appropriate null pointer indicates from the airplane's nose. Add if the station is to the right and subtract if to the left. For example, as shown in Fig 4 Case A, the direction to the station is known at position 3. The gyro heading at that instant is 110 deg. The left null pointer is 115 deg off the nose. Result is a course of 355 deg to the station from position 3.

Such arithmatic is apt to be confusing under the pressure of instrument flying and orientation when odd figures must be handled as in the above example. Therefore, after a pointer progression type of orientation, it is suggested that the course to the station be found by obtaining a nose null on the station.

Referring to Fig 4 Case B, it will be evident that computation is extremely easy when used with the heading progression type of orientation. A distinctive feature of the system is that the loop null position remains constantly at 90 deg to the heading. Therefore, as the orientation is completed, note the heading and add or subtract 90 deg as required to compute the exact course to the station. As illustrated at position 3 this course is 270 deg, 90 deg or 180 deg. This avoids both turning the airplane and rotating the loop.

Ascertaining the course from the airplane's position to a station is essential information regardless of what is done thereafter. When orientating on a non-directional transmitter such as a broadcast station, this furnishes the exact direction of the station and may be flown to the station. A radio range station, however, offers considerable choice as to subsequent plan of action. For in this case orientation not only provides the general direction to the station but automatically establishes in which quadrant the airplane is located. Referring again to Fig 4, this fact is easily visualized. Knowing the quadrant, it is usually better practice to proceed to the nearest radio beam than to fly directly to the station proper. The reasons for this will become more apparent in discussing homing procedures.

Selecting Nearest Beam

Picking the nearest beam and proceeding to it is a very simple technique. Referring to Fig 4, Case B, it will be seen that the exact bearing to the station at the completion of the orientation (position 3) has been established as 180 deg. Determine by inspection between which beam and the quadrant bisector this figure lies. In the case illustrated it lies between the 140 deg beam and the 205 deg bisector. Thus, the 140 deg beam is the nearest. Thereafter, assume a heading to converge upon this beam at 90 deg and change over to the standard range antenna. From this point on, the problem is strictly radio range flying.

Fig 4, Case A, illustrates the same procedure with slight variations. The course of 340 deg to the station having been established at position 4 as previously explained, the 320 deg beam is selected. Since a 340 deg course is only 20 deg different from the beam course, the airplane's position is shown to be very close to the beam. In such a position the quadrant bisector of 25 deg provides a sufficient angle of convergence to be used as a heading to the beam.

Homing

Homing is the term applied to the technique of flying toward a radio transmitter by use of the loop null signal for directional guidance.

The simplest method is to set the null position in line with the airplane's longitudinal axis (null pointer 0-180) and turn the airplane until a null signal is received. Maintain this null signal by adjusting the airplane's heading as required. Though this will keep the nose at all times directed at the station, it provides no allowance for possible wind drift. Thus, a curved track is usually made good as shown by Fig 5, Case A. Such a curve theoretically places the airplane directly into the wind at the moment of crossing the station.

The chief disadvantage of homing without drift correction is the curved track rather than the time lost (this may be negligible). To compensate for drift and thus achieve a straight track is very simple. Start homing as directed above with the loop null position on the nose and note the heading. Hold the heading and as the null signal is

D/F Navigation

(*Continued from page 148*)

lost, rotate the loop either right or left to regain it. If the drift is toward the *left*, the new loop null position will be to the *right* of the nose. Assuming it becomes 10 deg to the right, turn the airplane slightly more than 10 deg right (into the wind) and reset the loop null position approximately 10 deg to the left of the nose (downwind) and fly the null signal. Refer to Fig 5, Case B, positions 1 and 2 By one or two trials it will soon be possible to find a loop null setting and a heading which will *remain constant*. Drift has then been compensated and a straight track will be flown to the station. In setting the loop null position, the following simple rule is helpful: always set the loop null pointer to the *downwind side* of the airplane's nose.

Determination of Station

In practical navigation when homing on radio range station, there is very little advantage in holding a homing course directly to the range station. If "on instruments" and an approach must be executed, the best plan is to abandon homing when the rate of signal build-up indicates the station is not far distant and proceed to the nearest range beam. Since the actual instrument approach must be made using the range beams and conventional non-directive antenna, it is better practice to change over prior to the station rather than after reaching it.

Nevertheless, it may be necessary under *emergency conditions* to continue homing directly to the station. The chief difficulty in this is to determine the exact moment of passing over the station.

In airline aircraft a pilot is assisted in identifying station passage in one or two ways not available to the itinerant pilot. He may use the "Z" marker on ranges so equipped, or request his co-pilot to check the cone on a second receiver. Under emergency conditions and when the loop is expertly used, station passage can usually be determined without these aids. (Loop installation on the airplane is an important factor affecting the success of the procedure.)

While inbound on the homing course, maintain a null width of approximately 5 deg. As the station is approached, a more frequent rate of volume control adjustment will be needed to do this. At the same time this indicates the increasing proximity of the station. Check the null width with increasing frequency as the station gets near by either kicking rudder slightly or rotating the loop. Simultaneously, of course, the build-up of signal volume will be noticed.

Just prior to the station the tendency is for the null width to decrease very rapidly. Hold it at 5 deg if possible, until at the very moment of crossing the station, a distinct *surge* will replace the null completely. With the *loop in homing position* this surge corresponds to the conventional cone of silence. After the station is past, the null will reappear. Fig 6 B shows this graphically while 6 C diagrams the ideal change in volume control setting for the same procedure.

It will be evident from the above discussion that in addition to proper technique with the volume control it is necessary to have sufficient time interval over to the station *to be certain* the null has been replaced by the surge rather than simply lost while checking it. Sufficient altitude over the station is the only answer. Fig 6 A indicates the minimum altitude which should be used for the speed ranges plotted.

An alternative method for proving station passage is deliberately to fly slightly to one side of the station and follow the rapidly changing null by rotating the loop. The difficulty with this method is choosing the proper moment to abandon the homing procedure and adopt a heading which will pass the station to the side. For best results this should be done at the very last moment prior to reaching the station.

Engine Testing

(*Continued from page 65*)

pressure data are taken.

Upon the satisfactory completion of the cooling tests, the engine is run in 20 r.p.m. increments from the highest cooling test speed up to take off speed. These runs are made to get high speed exhaust back pressures to supplement the pressures taken during the cooling tests and the engine is run at each speed only long enough to take the necessary readings. Other standard tests will include two runs at 60 percent rated r.p.m., one to determine the effect of the carburetor hot air door, and another to determine the temperatures and air pressures at various cowl flap settings.

Miscellaneous special tests to be run depend on the peculiarities of the particular installation. Among them may be included other cooling tests with dif-

Recent Books

Berlin Diary, *by William L. Shirer* 605 pages, $3 Published by Alfred Knopf, New York

The editor of this page is usually too weary at going-to-press time to say anything about non-aviation books. We bring up Shirer's book because we firmly believe that every man, woman and child connected with U S aviation ought to know what has been going on in Berlin in recent years. If you have been wondering about the wisdom or justification for all the airplanes we are building, this account of the Hitler steam roller will make you wish we were going to build even more—and soon!

Suggestion to aircraft presidents: distribute this book to all your men and watch production go up ten percent

The Model Plane Annual, edited by *Fred Graham and Reginald Cleveland* 252 pages, $2 Published by Robert McBride, New York.

The jacket of this book states that some two million American boys are building and flying model planes—and anyone knows that two million boys can't be wrong This is a book about what model builders do and how they do it. There are chapters on design, materials, engines, air meets, indoor flying, seaplane models and other things.

You Can't Do Business With Hitler, *by Douglas Miller* 229 pages, $1 50 Little, Brown & Co, Boston.

If the firm you work for builds airplanes, engines or accessories and if you have been wondering where you will sell your equipment after the war, you better read this book. The author was the U S Commercial Attaché in Berlin and spent years trying to help Americans do business with Germany He says we haven't a snowball's chance in hell of selling our airplanes anywhere abroad if Hitler wins or draws.

Safety in Flight, *by Assen Jordanoff* 371 pages, $3 Published by Funk and Wagnalls, New York

This new Jordanoff book is a sequel to his popular "Your Wings" and "Through the Overcast" which have sold so many copies. The new book is advertised as "meeting the needs of post-graduate information for all those who fly and for the vital purpose of air defense" There are some 15 chapters dealing with weather, alternate airports, instrument methods, the use of radio accessories, instrument landings, and considerable other information As is usual with his books, the illustrations are excellent

Window Shopping

Aircraft Voltmeters and Ammeters—New 7 page bulletin describing instruments designed and rated in full accordance with U S and commercial specifications distinctive features, applications, construction prices. Dept 7 N 20 Westinghouse Electric Mfg. Co., E. Pittsburgh Pa.

"Brown Hot Blast Control System"—Bulletin fully describing system which has proved of great value in controlling manufacture of pig iron in a blast furnace. The Brown Instrument Co., Philadelphia, Pa.

History, Purpose and Practice of Metallizing"—Important and interesting booklet which explains metal spraying to those who could save time and money through its use. Metallizing Co of America, Chicago Ill.

Ampco Engineering Data—Sheet No. 86 which covers application of Ampco aluminum bronzes to aircraft, showing wide variety of parts used. Indicates importance of Ampco in aircraft design where highly stressed conditions make an unusually sturdy metal a necessity Ampco Metal, Inc., Milwaukee, Wis

Mitchell Fluorescent "Pocket Catalog"—Handy and helpful booklet containing pictures of entire line of Mitchell Commercial and Industrial fluorescent fixtures, together with brief engineering data on each unit. Mitchell Mfg Co., Chicago, Ill

Goodrich Two-In One Tape—New 4-page catalog describing use of tape combining functions of the tape known as "splicing compound" and friction tape. Used by makers of electrical motors and appliances, radio service men. B F Goodrich Co., Akron, Ohio

Getting the Most From Broaches—Ex Cell O Tooltips on care and maintenance of cutting tools A few simple rules which will repay in terms of longer life and a better product Ex Cell O Corp, Detroit, Mich

Fleetwings Hydraulic Equipment—Catalog illustrating a few of the more common uses of the most popular Fleetwings hydraulic devices Fleetwings, Inc Bristol, Pa.

Goodbye to Fuses"—Booklet that "tells all" about modern electrical protection for lighting circuits power Cutler-Hammer Inc. Milwaukee, Wis.

Homocarb Method For Carburizing—Action photos, diagrams, charts and photomicrographs which demonstrate how and why the Homocarb method is said to enable a heat-treater to get the case he wants Leeds & Northrup Co, 4934 Stenton Ave Philadelphia Pa

Vital to Defense—Du Pont Magazine giving the story on neoprene which has been placed on government priorities list E I Du Pont de Nemours & Co Wilmington Del.

Vibration Control—Lord Tube Mounting features and specifications and the basic engineering principles of vibration isolation. Unusually valuable because of engineering information contained in it, much of it never before published. Lord Mfg Co Erie Pa

Underwriters' Laboratories—Bulletin of Research on Current Carrying Capacity of Flexible Rubber Jacketed Cords Types S, SJ, and SV, Underwriters' Laboratories, Inc., Chicago Ill.

GS Tool Chests — Folder describing new line of GS Machinists Tool Chests necessary for toolmakers machinists and craftsmen. George Scherr Co Inc., 128 Lafayette St. New York N Y

New Departure—Shop Manual now available to all factory managers describing all kinds of bearings with instructions as to their use and care. New Departure, Division General Motors Sales Corp., Bristol Conn.

DeVilbiss Catalog 1E"—Brings all prices and specifications of standard spray finishing equipment up to date DeVilbiss Co 300 Phillips Ave., Toledo, Ohio.

Ex Cell O Tool Tips—New internal thread grinder described others in latest publication Ex Cell O Corp, Detroit, Mich.

Taber Abraser—Bulletin on new Research Model Taber Abraser, testing machine for evaluating resistance of surface finishes to rubbing abrasion Taber Instrument Co North Tonawanda, N Y

(Continued from page 150)

ferent propeller cuffs, reverse propeller pitch cooling tests, and tests of various engine accessories, such as heating boilers, generators and pumps

Use of the test data

During the three or four weeks that it generally takes to complete the testing data taken are continuously compiled and analyzed. Before any temperatures are analyzed they are corrected to compensate for the difference between the free air temperature on the day of the test and the maximum free air temperature anticipated for the operation of the particular airplane In searching out the flaws in the cooling system, a great deal of the total data taken may be used, on the other hand, the flaw may be found from just one or two definite indications.

As an illustration of the usefulness and inter-relation of the data, let us suppose that the oil temperature has been running too high We would first examine the total corrected temperature difference between the oil in and oil out of the engine If this difference is in line with that known to be reasonable from reliable previous experience, then we can say that the excessive oil temperature is not due to excess heating in passing through the engine We will then look to the oil cooling system The data available on the oil cooling system will include oil temperatures in and out of the cooler If these temperatures indicate that the oil cooler is not doing its job, then the condition and the amount of air passing through the cooler is investigated from the air pressures and temperatures taken in the oil cooler duct. From this investigation we may find that the temperature of the air passing through the duct is satisfactory, but that the amount or distribution is insufficient So by a process of elimination we may find just that data required to show the nature of the fault

Based on information obtained in this manner faults may be detected and corrected in almost any element of the power plant installation

Value of the engine ground test

In many instances engine ground tests would be unnecessary and uneconomical; however, in the case of high power, high performance aircraft of advanced design, especially large aircraft to be produced in quantities, the engine ground test has proved both economical and necessary It is economical because it discovers necessary design changes before the work on the contract has progressed to a point where changes become extremely expensive; it is at present necessary in order to speed production and shorten the time for flight testing

Cruising Control

(Continued from page 57)

put use a further step was made by tabulating the information given in Fig. 7, resulting in the table shown in Fig. 8. This has been found to be more readily usable under actual flight conditions than a graph. This table printed on a page 8½ by 11 inches, is pasted on the back of the flight plan board, which allows complete operating information to be obtained from two pieces of paper, back to back. Specific instructions for all allowable cruising conditions are readily available.

The construction of this table involves nothing new. However, the manner in which this information is applied may appear to violate some commonly accepted concepts of accuracy. The engine settings shown on the table are used directly without correction for density altitude or effect of carburetor air temperature or power. Also, the effect of weight variation on airplane performance is ignored. The correctness of this procedure can be demonstrated by an engineering analysis of our flight as follows.

Assuming altitude 11,000 ft, temperature 53 deg. F, required true airspeed 185 m.p.h. Referring to Fig. 7, 185 m.p.h. at 11,000 ft. will require 579 hp. However, our density altitude is 13,000 ft, and our engine power is reduced to 554 hp. because of the high carburetor air temperature. At 13,000 ft. 554 hp. will result in 183 m.p.h., according to calculations. Actually, our planes controverted these laws by doing 185 m.p.h., possibly because under such temperature conditions we are not carrying deicers.

The effect of weight on performance also is usually considered a tangible item requiring another calculation on the part of the crew in order to achieve accuracy. But the small errors introduced by these factors affect only true airspeed and are negligible in normal airline operation when weighed against the factors which are outside the pilot's ability to evaluate or control. A few such items are: tolerance of balloon run data, tolerance of engine instrument calibrations, atmospheric turbulence, variation of engine power with mixture strength and humidity. In the past we have required the utmost precision from the pilot concerning variables which will exert an influence of but one-half of one percent on performance, while ignoring variables affecting performance as much as 3 percent.

Our crew, having set the engines at 1860 r.p.m. and full throttle, will continue to the next check point and the accuracy of the original setting will then have been determined. Perhaps the expected zero wind is a 3 m.p.h. delaying wind and the speed must be stepped up to 190 m.p.h. for the remainder of the trip. A quick reference to the chart will give the figure of 1910 r.p.m., still full throttle, and a resulting indicated airspeed of approximately 155 m.p.h. The pilot knows he is still operating his engines properly, yet he has not been required to spend any time on calculating his problem. From here we can confidently expect arrival at Las Vegas within a minute of estimate without further attention to the engines.

It would be well to add here that the instrument indications by which the crew determines the airplane performance are read with a tolerance that would upset an engineer. Because of the position of the instrument with relation to the pilot and copilot, the tachometer indication is anyone's guess plus or minus 10 r.p.m. Similarly, the manifold pressure is never read more closely than .25 in. Hg, and the indicated airspeed is referred to in increments of 5 m.p.h. We believe this to be true of other operators using similar equipment.

In spite of these apparent inaccuracies, precision is obtained primarily because of the experience of the crew and, secondly, because these apparent inaccuracies tend to cancel one another. An example of this is the effect of varying gross weight. At constant gross weight our airplane will be two m.p.h. fast in summer and two m.p.h. slow in winter. However, summer loads will tend to slow the airplane down to the standard and lighter winter traffic will compensate in like manner.

We find that a high degree of accuracy has been obtained by regarding this table as a guide to true airspeed. The real precision must come from the attention of the crew to ground speed. Prior to the introduction of this technique we could expect a difference of three minutes in actual arrival time from the pilot's original estimate in a flight of 250 miles. This was while using equipment which was operated on constant power and with no attempt to control arrival time while in flight. This difference in 650 miles amounted to as much as 5 minutes. Because of the inflexible operating technique then used, these differences can be ascribed to the variable accuracy of balloon run information. Today we are meeting

(Turn to page 156)

True Air Speed, in Miles Per Hour 160 RPM	MP	IAS	165 RPM	MP	IAS	170 RPM	MP	IAS	175 RPM	MP	IAS	Standard Temp. °F.	Altitude in feet	True Air Speed, in Miles Per Hour 180 RPM	MP	IAS	185 RPM	MP	IAS	190 RPM	MP	IAS	195 RPM	MP	IAS
												−7.5	19,000												
												−4	18,000												
												−2	17,000												
												2	16,000				2030	24.4	140						
1750	23.4	121	1790	23.7	125	1830	24.0	128	1880	24.2	124	5.5	15,000	1940	24.7	138	2000	25.0	143	2050	25.6	147			
1710	24.1	[illegible]	1750	24.4	[illegible]	1800	24.6	132	1850	24.8	[illegible]	9	14,000	1910	25.2	141	1970	25.7	145	2025	26.3	[illegible]			
1660	24.8	126	1710	25.[illegible]	131	1760	25.3	134	1815	25.6	138	12.5	13,000	1870	26.0	143	1925	26.4	147	1990	27.0	[illegible]	2050	27.5	157
[illegible]	25.3	127	1680	25.7	132	1725	26.0	136	1780	26.3	141	16	12,000	1840	26.7	146	1900	27.2	150	1960	27.5	152	2025	28.4	159
1600	26.1	130	1650	26.4	124	1700	26.7	139	1750	27.0	144	19	11,000	1810	27.5	148	1870	28.0	153	1940	28.5	157	2000	29.25	162
1570	26.5	133	1615	27.2	137	1670	27.5	141	1725	27.9	146	23	10,000	1775	28.3	151	1840	28.5	155	1940	29.25	160	2045	29.5	165
1540	27.6	134	1580	28.0	139	1640	28.3	144	1700	28.7	148	26.5	9,000	1785	29.25	153	1880	29.25	158	2070	29.5	162			
1520	28.4	137	1560		141	1610	29.1	146	1700	29.25	151	30	8,000	1790	29.5	156	1890	29.75	160	2000	29.75	166			
(Wide open Throttle)																									
1490	29.2	139	1550	29.5	144	1630	29.5	149	1730	29.75	154	34	7,000	1825	29.75	158	1950	30	163	2045	30.25	168			
1480	29.75	141	1565	29.75	147	1655	29.75	151	1750	30	156	37	6,000	1850	30.25	161	1980	30.25	[illegible]						
1500	30.25	144	1580	30.25	149	1670	30.25	154	1770	30.25	158	41.5	5,000	1875	30.5	164	2000	30.75	[illegible]						
1510	30.5	147	1600	30.5	152	1700	30.75	157	1800	30.75	162	45	4,000	1920	31	167	2045	31.25	172						
1530	30.75	149	1620	31	154	1735	31	159	1830	31	165	48.5	3,000	1950	31.25	170									
1550	31.25	152	1645	31.25	156	1750	31.25	162	1865	31.5	167	52	2,000	[illegible]	31.5	173									
1570	31.5	154	1670	31.5	159	1775	31.75	165	1900	31.75	170	55.5	1,000	2040	32	175									
1585	31.7	157	1700	31.75	162	1800	32	167	1880	32	172	59	Sea Level												

Fig. 8. The information of Fig. 7 is shown here in tabular form. Cruising chart for Douglas DC-3 and DST-A airplanes, based on P & W S1C3G engines with Stromberg PD12B8 injection type carburetors and Hydromatic propellers, geared 16 to 9 using 140 B.M.E.P. with 80 octane fuel. Table designed for standard conditions. MP is manifold pressure. IAS is indicated air speed.

BENDIX RADIO NEWS

BENDIX RADIO

OCTOBER, 1941 Published by BENDIX RADIO CORPORATION, Baltimore, Md. Cable Address BENRAD

MID-CONTINENT INSTALLS BENDIX DUAL AUTOMATIC COMPASSES

Simplifies Navigation, Increases Safety, By Automatically Providing TWO Fully Corrected Bearings of All Times

Thoroughly Tested by CAA In Its Own DC-3

The Sign of Safety—the Bendix Dual Loop Installation on the under-body of a Mid-Continent Airliner. The Bendix Dual Automatic Compass enables the pilot to know at *all* times the true heading and position of the Airliner in direct relation to *two* known points. Both readings are automatically indicated on the Azimuth Indicator which is direct-reading and fully compensated for quadrantal error.

Direct-Reading Azimuth installed in direct line of vision from the pilot's position enables him to check his course at any time without requiring compensation tables, without readjusting the Compass receiver for two positions. This results in elimination of the natural movement of the airliner between two positions when taken with a single automatic or manually operated Radio Compass.

Thomas F. Byon, III
President of Mid-Continent Airlines, Inc. who has been responsible for Mid-Continent's pioneering position in many phases of airline operation.

Vernon A. Dorrell
Vice President in Charge of Operations, under whose direction the Bendix Dual Radio Compass was tested and finally adopted for use by Mid-Continent.

Deryl De Voelt
Superintendent of Communications of Mid-Continent Airlines, Inc. who was responsible for the installation of Bendix Dual Automatic Compasses.

Controls for the two MN-31 Automatic Radio Compasses are conveniently located above the pilots for quick tuning to facilitate the changing of bearing points in flight. The Receivers and other components are located in the radio compartment, in front of the forward baggage compartment.

BENDIX RADIO—STANDARD FOR THE AVIATION INDUSTRY

Barrie and Cutting

(Continued from page 57)

our original estimates within one minute because the crew has available the necessary information to control cruising performance.

The emphasis placed on indicated airspeed is at variance with the policy of some operators. The usual objection to using this instrument as a basis for navigation is the possible tolerance of its indication. For a high degree of instrument accuracy, frequent flight calibrations would be necessary.

As previously shown, we accept a comparatively wide tolerance in the airspeed indication but are convinced that the data of this degree of accuracy is valuable. This instrument gives the pilot the most tangible evidence that the power expended is resulting in the expected performance. The table is sufficiently accurate so that the three factors tabulated, r.p.m., manifold pressure, and indicated airspeed, fall together as a unit within the accuracy that these gauges are read. This one fact alone has been a large factor in gaining the pilot's acceptance of these instructions. The major purpose of the instructions, as previously stated, is to translate engine power into airplane performance. The engine power, as determined by r.p.m. and manifold pressure, is translated into airplane performance as measured by the airspeed indicator.

An interesting by-product has resulted in having these three readings so closely related. As the personnel expect to have these related readings come together, the variation of any one is a quick indication of ice formation. For instance, if at 10,000 ft. we have 1940 r.p.m. and 29.25" manifold pressure and indicated 150 m.p.h. instead of 160 m.p.h. we look for ice on the wings or pitot head. Similarly a drop in manifold pressure will give a warning of engine ice. It is true that these conditions would be manifested otherwise, but because the crew expects these three quantities to line up as shown in the table, they are more quickly aware of adverse conditions if one quantity is out of line.

Experience has dictated the limits of cruising control. A true air speed of 195 m.p.h. at 2050 r.p.m., or 630 hp., is the maximum. This is governed by considerations of practical engine limitations. Exceeding this power will result in rapidly increasing maintenance costs. The minimum is 135 m.p.h. indicated airspeed. At speeds slower than this the airplane is too slow to react for continuous flying. Therefore, if our headwind is too great, we fly at 195 m.p.h. true air speed and arrive behind schedule. If the favoring wind is sufficiently great we arrive ahead of time, despite operating at minimum allowable cruising speed. Within these limits we exert all possible means to maintain schedules as precision of operation creates a favorable impression with customers. One factor assisting in adherence to schedule is that the required average speed leaves a sufficient margin of power to compensate for normal delaying winds and ground delays.

Where favoring winds exist the airplane is accordingly slowed down. This policy may be objected to by some operators who prefer to take advantage of favorable winds by arriving at the next destination ahead of schedule, arguing that costs are calculated on the basis of hours flown. However, as departure from the next stop can seldom be made ahead of schedule, the irritation of the passengers resulting from the increased length of time on the ground is a factor that must be considered. With constant high B.M.E.P. operation we achieve the speeds required by the schedule with maximum fuel economy for the desired airspeed.

All that has been said above applies directly to continental airline operations where flights are relatively short and maintenance of schedules is a major factor. However, in long transoceanic flights the requirement of maintaining scheduled time is secondary to achieving the maximum fuel economy possible with the airplane and engine combination being used. The result is that such operations are usually conducted at the maximum range condition of the airplane, regardless of over-water speed. This is essential from the standpoint of maintaining a large margin of reserve fuel and also to avoid carrying excessive fuel, which would reduce pay load.

For scheduled airline operations over land the new operating technique described above has been used for more than a year and sufficient experience has accumulated to warrant the following conclusions:

1. The main benefit derived has been the simplification of the pilot's cruising calculations. He has readily available in flight accurate and definite instructions for obtaining the desired airplane performance which, in its entire range, is within engine limits.

2. Whereas the fuel savings anticipated from the use of a high constant B.M.E.P. have not been definitely apparent, it is felt that Western Air Lines has done well to hold fuel consumption constant. Increased ground delays and traffic upsets attendant on the increasing defense activities of the past year

would have increased the amount of fuel used under previous methods.

3. The average operation has been accomplished at a reduction in engine speed of about 200 r.p.m. even though at the same average power as previously used. The resultant decrease in cylinder and piston wear alone makes this method of operation desirable.

4. The slower engine speed provides a quieter cabin, which is appreciated by passengers, especially on sleeper runs.

5. As a result of the high B.M.E.P. feature of the operation, we have found that the greatest care must be given to the ignition system. An engine and propeller in excellent condition will operate through all cruising speeds of from 1500 to 2050 r.p.m. without vibration. However, this type of operation does make more readily apparent any deficiency coming from the ignition harness or spark plugs, and will not allow the magnitude of propeller unbalance tolerable with operation at lower B.M.E.P.

Where vibration from one of these sources begins to develop in flight, it has been the rule to reduce the manifold pressure by 2 in. Hg., change the mixture to automatic rich and select a different r.p.m. which will move the engine speed out of the vibration range and allow a safe flight to the next station.

Perhaps the best summation of the description of Western Air Lines' method of cruise control is that the pilots like it, use it, and make it do what its originators intended it to do.

False Horizon

(*Continued from page 73*)

The Bradbury-Meuron apparatus for counting condensation nuclei has been operating for two years at Stanford. It makes an excellent standard for comparing results obtained in similar experiments such as that performed by Fryer. In this apparatus an air sample is drawn into a Wilson cloud chamber and expanded. The expansion cools the air sample to below the saturation point with the result that the water vapor in the sample condenses upon the nuclei present. A light beam shining through the cloud chamber impinges on a photoelectric cell, and a relationship has been established between the amount of light extinction and the number of nuclei present. A galvanometer is arranged to measure and record the result on photographic paper mounted on a rotating drum. The apparatus examines a sample in fifteen minutes, and since it is operating continuously, the record shows the number of condensation nuclei present in the atmosphere at the field at intervals of fifteen minutes throughout the day.

Fryer's measurements of atmospheric haze checked closely with the Bradbury-Meuron apparatus as may be seen in Fig. 1 which represents a 48 hour period starting at midnight May 23, 1940 and ending at midnight two days later. Haze intensity and relative humidity are plotted in this figure against time, and the nuclei count given by the Bradbury-Meuron apparatus during this period is plotted on the same figure for comparison.

In Fig. 1 the relationship between atmospheric haze and relative humidity is clearly indicated. The haze curve follows the relative humidity curve almost exactly in the early morning hours before sunrise when relative humidity is high. It is at this time that the non-hygroscopic particles in the air—dust and smoke—have been found to be at a minimum. The nuclei density is also low at this time, but the scattering of Fryer's light beam showed a maximum of haziness was occuring. This is because of the great effect of relative humidity in increasing the size of condensation nuclei and thus producing haze.

Fig. 2 is a plot of the atmospheric haze found by Fryer with his light beam method for a longer period from May 12, 1940 to May 24, 1940. Relative humidity is again plotted in this figure for comparison with haze intensity, and it may be seen that haziness rises and falls with it.

Fig. 3, a plot of the daily averages of Fryer's observations, shows even more clearly the effectiveness of high relative humidity in producing haze. On this plot of the averages, haziness reaches a maximum at about five o'clock in the morning, which in May has been considered a most propitious time for the beginning of flight training operations. This is just about sunrise, but the humidity is still high and the nuclei density is increasing. (See Fig. 1). With the coming of sunrise the nuclei density is still high, but the haziness decreases because the relative humidity decreases.

It is in these early morning maximum haziness periods that the upper boundary of the haze layer is occasionally very sharp, and presents to the aviator a well-defined, false horizon sometimes called the "dust" horizon.

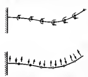
The investigation of haziness is being continued by Fryer over other months of the year, and it is expected that his further measurements of haziness and the related factors may provide data on this common cause of poor visibility that may be of value to aircraft operators.

Aircraft Flutter

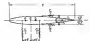
(Continued from page 63)

The unit body method represents a structure as a mechanical system of rigid airfoils and other rigid components elastically or otherwise coupled. Each component corresponds to a definite portion of the aircraft structure. This method is very helpful in fundamental research upon the influence of structural and aerodynamic properties (for instance, the effects of a control surface and tab, of masses and stiffnesses, of the location of the mass axis, elastic axis, etc.) because the structural properties are represented by the coupling scheme between the component units, by the elastic restraints, and by the masses affected. Fig. 4 illustrates the unit body analysis method for the study of a ternary flutter mode. This mechanical system can be compounded into an accurate model of an aircraft structure.

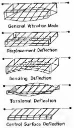
The method of predetermined deflections considers the deflections of the whole system as formed of certain elementary deformations and any linear combinations of these postulated deformations. No further specification is necessary concerning the internal mechanism of the structure. As long as the displacements are linearly independent the given elementary internal deformations added to the displacements of the system as a whole determine the number of its degrees of freedom. This method determines the important factors in a few degrees of freedom defined by the same number of elementary deformation functions. The addition of more degrees of freedom corresponding to refinements in the choice of the elementary deformations to approximate more closely the true displacements represents an improvement of the approximation. These principles prove that this is really the Rayleigh-Ritz method of dynamical analysis. Fig. 5 is a complete analysis of the vibration modes of a biplane bay. It is quite apparent that an accurate model can be constructed using only three or four degrees of freedom.



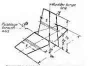
SECTIONAL METHOD
ALTERNATE MODELS OF SECONDARY CANTILEVER VIBRATION
FIG. 3



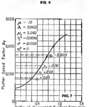
UNIT BODY METHOD
TWO DIMENSIONAL TERNARY FLUTTER MODEL
FIG. 4



METHOD OF PREDETERMINED DEFLECTIONS
ANALYSIS INTO COMPONENT MODES
FIG. 5



SCHEMATIC DIAGRAM- FUSELAGE TORSION RUDDER FLUTTER WITH HORIZONTAL SURFACES CONSIDERED
FIG. 6



Typical Use of Theoretical Flutter Model

As an example of the use of a theoretical flutter model, such as shown in Fig. 5, a brief analysis is summarized of a fuselage torsion rudder flutter study considering the aerodynamic damping effects of horizontal tail surfaces. Aerodynamic damping differs from structural damping in several fundamental respects. Structural damping is an internal elastic phenomenon affecting only the structural rigidity. Aerodynamic damping is an external reaction due to the movement of adjacent lifting or control surfaces. The consequent excitation of adjacent surfaces into modes stable for these respective surfaces absorbs energy from the principal vibration system and is an effective damper.

Fig. 6 is a schematic flutter model of a single tail configuration. The modes of vibration are oscillation of the rudder about its hinge line, and rotation of the whole tail unit about the fuselage torsional axis. By rotating the figure 90 deg. clockwise one obtains a schematic model for the damping effect of the vertical end plate surfaces for stabilizer elevator flutter mode of a twin tailed configuration.

The aerodynamic damping effect is a function of three parameters:

(1) Ratio of damping surface semi-span to the reference surface span $\frac{b_h}{2b_v}$

(2) Ratio of damping surface chord to the reference surface chord $\frac{T'}{T}$

(3) Ratio of damping surface mass per unit span to the reference surface mass per unit span $\frac{m'_F}{m_F}$

Fig. 7 is a representative figure to illustrate the influence of the span ratio parameter for typical single tail configuration. On this figure have been

(Turn to page 162)

Casting

(Continued from page 79)

pattern the mold is inspected to eliminate any defects on casting surfaces or core prints which might later affect the assembly of the mold. The molds are then assembled, all gates and risers cleaned perfectly, cores are securely fastened into position and the two halves of the mold are placed together on the steel pins and bolted together tightly. All gates and risers are then closed over with muslin or paper to prevent entrance of any foreign particles during the Antioch processing.

The molds are then turned over to the processing department, placed on racks carrying approximately 2,000 lb., of plaster molds and processed and dried, so that there is a minimum required moisture left in the molds. When dry, the molds are cooled to room temperature, opened, inspected for any changes which might have occurred during processing, reassembled and again bolted together. Metal for the castings is melted in 400 lb. crucible type gas-fired tilting furnaces under accurate temperature control and after fluxing the metal is brought to the indicated pouring temperature.

After cooling off, the Antioch plaster molds are broken up, all cores and any adhering plaster removed. At this point all castings are given a preliminary inspection for visual defects. After preliminary inspection, gates and risers are removed and the castings are sent to the finishing department. Here all "flash" from parting lines and core joints is removed. The gates and risers are finish ground to remove any-

(Turn to page 188)

Aircraft Flutter

(Continued from page 160)

cross-plotted the structural damping factors for the same configuration, neglecting the aerodynamic damping of the horizontal surfaces.

Fig. 8 shows the influence of variations of the chord ratio for a constant mass ratio. From this figure it is concluded that the chord ratio effect within the range of general design variations is of secondary importance.

Fig. 9 shows the effect of variation of the mass ratio holding the other two parameters constant. In general the mass ratios will be approximately unity and hence a linear correction factor can probably be justified.

In summarizing the results of this brief study of a practical application it is apparent that the flutter theory can be successfully applied to aircraft structures to predict flutter characteristics quite satisfactorily as long as the theory is applied in such a general fashion that all of the factors affecting the flutter speeds and frequencies are included.

References

Aircraft Airworthiness Section Report No. 22—"Flexure Torsion Binary Flutter."

Aircraft Airworthiness Section Report No. 23—"Perpendicular Axes Control Surface Binary Flutter."

Aircraft Airworthiness Section Report No. 24—"Parallel Axes Control Surface Binary Flutter."

(*Aircraft Airworthiness Section Report No. 22* is currently being published and *Aircraft Airworthiness Section Reports Nos. 23 & 24* are to be published within the near future by the Civil Aeronautics Administration.)

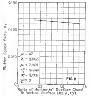


FIG. 8

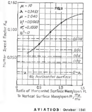


FIG. 9

Shanley on Beads

(Continued from page 58)

sion stresses are always normal to each other results in wrinkles appearing in the direction of the maximum tension stresses. This sometimes causes confusion and leads to the erroneous impression that a tension "field" actually causes the wrinkles. The wrinkles themselves are simply evidence of the buckling of the sheet under compression stresses and represent a column failure which occurs in a large number of waves instead of one single wave.

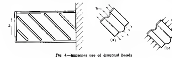


Fig. 4—Improper use of diagonal beads

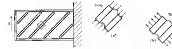


Fig. 5—Improper use of diagonal beads

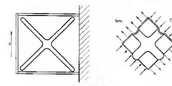


Fig. 6—"Crossed" beads

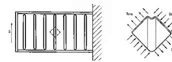


Fig. 7—Vertical beads

Flat Plates Under Shear Load

Since beads are often used to stiffen members which transmit shear loads it is of particular interest to examine the stress conditions for such a bead. Fig. 3 shows that when a flat plate is subjected to a pure shear loading, the maximum tension and compression stresses occur along 45-degree lines and are, of course, normal to each other. This is indicated in Fig. 3 by the solid and dotted lines. Fig. 3 also shows the stress condition for a small element of the sheet.

It might be supposed that the proper use of a bead in this case would consist in placing it in the direction of the compression stress. This is shown in Fig. 4. Fig. 4a shows that the reasoning is correct as far as compression stresses are concerned, but that the bead has serious consequences when viewed from the standpoint of tension stresses, as shown in Fig. 4b. In fact, this type of bead will practically destroy the value of the sheet as far as carrying diagonal tension is concerned, as the bead will "open up" under the action of the tension loads. This is almost equivalent to cutting slots in the sheet between the diagonal beads.

Fig. 5 shows what happens if we run the beads parallel to the direction of the tension field. Fig. 5a indicates that the bead has no helpful effect as far as the tension field is concerned, but it practically destroys the ability of the sheet to carry compression stresses, as shown in Fig. 5b. This type of bead simply amounts to putting wrinkles into the flat sheet before the load is applied and is obviously a waste of time and money as far as structural efficiency is concerned.

Crossed Beads

Fig. 6 illustrates a combination of the two preceding cases, in which the beads are crossed at 45-degree angles. As shown by the small sketch, this arrangement combines the bad features of both the preceding arrangements. From this sketch it is evident that there will be a bead normal to the compression stress and this bead will tend to open up under loading. Consequently, this type of construction not only fails to increase the strength of the flat sheet appreciably but greatly reduces its rigidity under shear loads.

Vertical Beads

Fig. 7 illustrates the use of "vertical" beads for reinforcing a flat shear beam. At first sight it might be supposed that the vertical bead would tend to open up under the action of the diagonal tension stresses. By referring to Fig. 7a, however, it can be seen that the effect of the tension stresses is exactly offset by the action of the compression stresses. It is interesting to note that this condition is nothing more than an example of the so called "geodetic" principle of design, which utilizes the counterbalancing effects of curved force systems which are mutually perpendicular.

From this example it can be seen that the vertical 90-degree bead is the best type of bead to use in reinforcing a shear beam subjected to "pure" shear loading. The term "pure," as used here, indicates equality of the diagonal tension and compressive stresses. Obviously if the tension stress exceeded the compression stress there would be a tendency

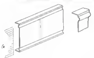


Fig 8—Use of bead to increase bending strength   Fig 9—Compression stress trajectories

for the bead to open up or flatten out. This condition can be obtained if the shear load is increased to a point causing buckling of the flat sheet between the beads. Under such conditions, any additional shear load must be carried by the tension field only, thereby destroying the balance between the diagonal tension and compression fields. In general, it is desirable to prevent buckling between the beads in all cases where high structural efficiency and rigidity are desired. This leads to relatively close bead spacing.

As a limiting case of the vertically beaded web, we have the vertically corrugated web which is obtained when the beads are placed very close together. This type of shear web has been found to be extremely efficient structurally for a wide range of loading conditions. The above discussion indicates the manner in which a shear load, represented by diagonal tension and compression fields, is carried through a corrugated beam. Here, again, the principle is the same as that employed in geodetic construction.

Before leaving the subject of corrugated beams, it might be well to point out that this type of beam will not develop its full efficiency or stiffness unless the free edges of the corrugation are restrained (riveted) on both sides. The only alternative to this is to "wash out" the corrugations at the edge of the sheet. This tends to reduce the strength of the web somewhat, as it introduces some fairly large unsupported flat areas between the corrugations. The corrugated web attached on one side only may be used to advantage if maximum efficiency or rigidity are not necessary.

Stiffening of Beams Carrying Bending Stresses

Fig. 8 illustrates the use of a bead to increase the bending resistance of a simple formed channel. In this case the bead is run parallel to the outer edges of the channel and as close to them as possible. The reason for this can be seen from Fig. 8 in which the axial stresses, due to bending, have been indicated to the left of the beam. It is obviously desirable to place the bead as near the outer fibre as possible, where the compressive stress is at a maximum. This type of beam must, of course, carry shear stresses also, and it is sometimes desirable to employ both vertical and longitudinal beads. When this is done it may be convenient to permit the vertical beads to merge with the longitudinal beads, as indicated by the dotted lines in Fig. 8. At first sight this may appear to be an example of a "crossed" bead, but the situation is not nearly as serious as that previously discussed under this subject. From this example it may be seen that the question of "crossed beads" is often confused with the more fundamental question of the direction in which the beads should be placed.

It should be noted that in this simple type of beam the problem of providing sufficient strength against bending is usually much more serious than that of carrying the shear stresses. Consequently, it is probable that vertical beads would not be needed at all, and in fact it might be possible in many cases to use lightening holes in the web.

Combined Loads

The foregoing examples have been based on a clear-cut distinction between shear loading and axial loading. It is not always possible to make such a distinction and we often find that structural members are subjected to a very complex stress distribution. This can be illustrated by the case of a rectangular beam as indicated in Fig. 9. Even in this simple case the direction of the maximum normal stresses (tension and compression) is somewhat complicated. The dotted lines in Fig. 9 indicate the direction of the maximum compression stresses (Ref. Timoshenko and MacCullough, "Elements of Strength of Materials" page 135, Fig. 162). It can be seen that the compression stresses cross the neutral axis at an angle of 45 degrees, but that this angle changes constantly as we move from one edge of the beam to the other. Although not shown on the sketch, the direction of maximum tension stresses would be indicated by a similar series of curves which would be perpendicular to the dotted lines shown.

It is theoretically possible to plot such stress trajectories for any structure under the action of known external loads. Assuming that this can be done for a given case, it is still difficult to determine the proper location of beads. At first sight it might appear that the beads should be run along the compression stress trajectories in order to keep them located in the direction of maximum compression stress. This argument may be shown to be fallacious, however, by referring to the discussion of Fig. 4, in which we found that placing the bead parallel to the compression stress destroyed the effectiveness of the tension field. Since there will almost always be a tension field of considerable magnitude, and since the tension field always acts normal to the compression field, it can be seen that placing beads along the direction of maximum compression stress is not the solution to the problem. In fact, this procedure not only destroys the ability of the sheet to carry the tension field, but destroys the validity of our original analysis by which we determined the internal stress distribution. Consequently, we end up with an entirely unpredictable condition and the chances are that the beads will do more harm than good.

This discussion will at least indicate why the question of where to place the beads has never been entirely solved on an analytical basis. We are often faced with a complicated problem, not only involving an uneven distribution of external loads, but requiring that the part be designed for two or three different loading conditions. Under these circumstances, it is usually necessary to make an intelligent guess as to the best location for the beads and to run a static test to determine whether the member will carry the load. Most of our beaded structures, with the exception of very simple cases, are therefore developed by the "cut and try" process.

The Truss Type Beam

One of the few cases in which the location of beads is a relatively simple matter is that of the truss type beam. Here we deliberately cut away large portions of material, thereby compelling the stresses to flow axially along the remaining diagonals or verticals. In such cases the answer is, of course, to run the bead parallel to the edges of the diagonal. The fact that we have cut away the material between diagonals prevents a tension stress from forming across the bead and thereby eliminates the condition shown in 4b. The only difficulty with this type of construction is encountered at the ends of the diagonals where it is necessary to "wash out" the bead or to make it merge into the

bead from another diagonal. Experience has shown that this type of beam usually requires special reinforcement or additional beads at the ends of the diagonal members, due to the relatively large flat sheet area introduced at the joints.

Fig. 10 illustrates a typical use of beads which at first sight may appear to be quite effective. It can be seen, however, that the diagonal beads in this

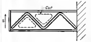


Fig. 10—Truss type diagonal bead

case are subject to the same criticism that was made in connection with Fig. 4 and 5. In other words, the presence of a diagonal tension field will tend to open up the beads that are carrying the compression stresses. For maximum structural efficiency it would probably be better to cut away the excess material between the beads, as indicated by the dotted lines of Fig. 10. The decision as to whether this should be done will depend largely on the intensity of shear loading involved, as it is often unnecessary to achieve the maximum in structural efficiency. In such cases production considerations are of greatest importance and the designer should attempt to utilize the simplest possible type of construction.

Other Uses of Beads

As previously noted, beads may also be utilized to stiffen a flat sheet against normal pressures or to prevent vibration in service. In such cases the only fundamental principle involved is to run the beads across the shortest dimension of the sheet, as it is obvious that a strip cut parallel to the beads has much more bending stiffness than a strip cut across the beads. Consequently, we should try to place the stronger strip across the shortest dimension in order to achieve maximum rigidity against normal pressures. The use of diagonal or crossed beads under these conditions is therefore open to question on the same grounds that were used in the discussion of shear beams. Likewise, any attempt by the designer to invent a new system of beading for such cases is likely to be a waste of time as it is impossible to predict very accurately the action of a complicated system of beads.

Summary of Basic Principles

Although it is impossible to set up a system that will give complete answers to the bead problem, a number of simple rules can be stated, based on the foregoing discussion. These should be clearly understood by the designer and should be applied to all cases in which beads are to be used.

(a) For members loaded in pure *compression* (that is, having no tension field at right angles) the bead should be placed in the direction of the compression stress.

(b) For sheets subjected to pure *shear* stress (that is, equal diagonal tension and compression fields) the bead should be placed "vertically," that is in the direction of the shear load and across the short dimension of the sheet.

(c) Principle (b) can be further extended to state that in general beads should be placed midway between the direction of the maximum tension and compression fields (that is at 45 degrees to each).

(d) It is inefficient to use diagonal beads for a flat plate under pure shear load. This holds for either direction of the diagonal, and particularly for the use of crossed diagonal beads, which is probably the most inefficient type of construction.

(e) The main disadvantage of the bead is the fact that it destroys the continuity of the sheet in its own plane and will therefore cause either a flattening or bowing of the bead under any loading condition, except the following:

(1) Direct tension along the bead with no cross loading.

(2) Direct compression along the bead with no cross loading.

(3) Pure shear in the direction of the bead (i.e., equal diagonal tension and compression fields at 45 degrees to the bead).

(f) In all cases where the direction of maximum normal stresses is not clearly defined or is subject to variation under different loading conditions it is best to adopt one of the following ideas:

(1) Avoid the use of beads entirely resorting to stiffeners instead.

(2) Adopt a truss type of construction in which material between beads is removed, thereby compelling the stresses to flow along the direction of the bead. (Note: The choice between a truss type of beam and flat plate type is based largely on access considerations. In most cases the flat sheet is preferable.)

(g) In using beads for stiffening against normal pressures or vibration the beads should be run across the shortest distance between points of support.

(h) For maximum structural efficiency, shear beams should be designed either as stiffened plate girders or "vertically" corrugated webs. In the latter case it is necessary to pay particular attention to the edge attachment conditions.

(i) "Blending" of one bead into an-

Aircraft Clamps

(Continued from page 84)

Northrop Kelvin Bridge Ohmmeter.

The heat treating furnace used for increasing the tensile strength of the clamps was built to order. It is loaded with an electric hoist and has a capacity of 32,000 to 320,000 parts per shift, depending upon the size clamp being treated.

Also built to order were the steam kettles and other equipment of the thermo-welding unit, developed by the American Tire Machinery Company and using a Steamaster boiler.

The bulk of the production duties fall to the 22 and 12-ton Marshalltown presses, with their multi-stage dies. Both have an output of 48,000 completed bare clamps an hour, with the larger sized clamps being made on the heavier press. The heavier machine also is used for special size clamps up to seven inches in diameter. Another die used on the 12-ton press stamps out cushion clamps in sizes from an eighth to three-

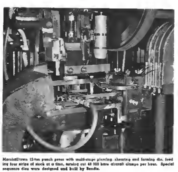
Bendix clamp department thermo-welding equipment developed by American Tire Machinery Co. with a Steamaster boiler

quarters of an inch at the rate of 48,000 per hour. The 16 ton press is used for both bare and cushion clamps up to three inches in diameter.

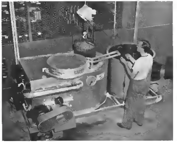
The plant has two six-ton presses. One is used for the smaller sized thermo-welded cushion clamps, one-eighth to half-inch, and for special blanking and piercing operations. The other six-ton press is used exclusively to do a forming job on lug-type clamps.

The shop's seventh punch press, the one-ton machine, is used to draw the eyelets for the thermo-welded clamps and also for experimental work.

Development of the new cushion clamp and tooling up for the present high rate of production involved research and tooling considerations that might well have consumed a year or more, but under the pressure of national defense needs the job was done in five and a half months.



Marshalltown 12-ton punch press with multi-stage piercing, shearing and forming die, feeding four strips of stock at a time, turning out 48,000 bare aircraft clamps per hour. Special sequence dies were designed and built by Bendix.



Knapp Despatch air-circulated furnace heat-treating equipment installed in Bendix clamp department.

other is not in itself objectionable, provided that it does not violate any of the fundamental principles governing the efficient location of beads.

(j) "Crossed" beads are to be avoided if structural efficiency or stiffness is desired (*A companion article on the technique of forming hydro-pressed beads in sheet metal, by J. A. Petrie, begins on page 59*)

5 Warpage is greater and re straightening after forming is increased with the external beads.

There are times when it is structurally essential that external beads be used. Otherwise it would be deemed advisable to eliminate them completely from our design standards However, with judicious use of them and close control of the elements designed in the vicinity of external beads, we feel that they can be retained as part of our design standards

Cost of Internal and External Beads

To the designers, the aspects of strength and weights are naturally of prime importance when a choice is to be made between two or more proposed designs However, another factor, cost, very definitely enters the picture The Cost Control Staff has investigated conditions affecting the use of internal and external beads and has on record information regarding specific applications

Due to the number of variables entering into the cost of tooling, fabrication and use of beaded parts, it is not feasible to attempt to establish any overall statement or formula regarding the costs of beads In general, however the following points may be considered

1 Straight beads, whether internal or external, are more economical than curved beads

2 Circular beads are more economical than irregularly curved beads

Curved beads, if circular, cost approximately 18 to 20 percent more than straight beads If the curves are irregular, the cost increases rapidly due to machinery setup, complicated forming, etc. Blending of beads, although desirable from a stress viewpoint, is expensive because of the hand work involved.

No attempt will be made to even approximate costs in this paper as each specific application should be investigated individually

Petrie on Beads

(*Continued from page 59*)

The depth to width ratio on the external bead is 1 to 2 meaning that the bead depth is ½ its width.

It is the elongation factor given in Lockheed Paper No 36 that determines just how closely together external beads can be placed in relation to one another (See Fig 4)

The internal bead presents no problem as to spacing between beads inasmuch as the stretch all takes place in the bead itself and not from the adjacent area.

Obviously, it becomes necessary to set up certain limitations on curved beads and beaded lightening holes That is, the edge radius of the bead on the flat sheet development must not be less than a certain minimum This radius remains the same for a given bead whether it extends through a complete circle or any part thereof inasmuch as the elongation factor for the material is constant. This applies to both internal as well as external beads as shown in Fig 5 (See Lockheed Paper No 36, Sheet Metal Mathematics)

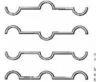


Fig 5—Combinations of beads

Certain combinations of external and internal beads can be used advantageously Intersecting beads may blend into one another at almost any angle, providing they are properly faired as shown in Figs 6 and 7

Mention might be made at this point that designers frequently reverse beads that is, they sometimes desire to use an internal bead on an external application or, again, they may desire to use an external bead on an internal application

While this is not impossible, it does create serious tooling and fabrication problems that are not in keeping with low tool cost and good production.

A brief resume of all the foregoing can be summed up in the following

Avoid the use of external beads wherever possible If beads are necessary use internal ones

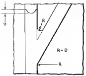


Fig. 6—Blending internal beads

In stating strong preference for the internal bead, we are in substance stating

In hydro-press work, keep all flanges, beads, lightening hole flanges and other elements all in the same general direction for the flat sheet.

Objections to the external bead are

1 Accurate determination of blank is almost impossible

2 Indeterminate effect which external bead has upon adjacent elements

3 Inability to achieve standard depth of bead without cracking when beads are in vicinity of other elements in the sheet which limit the amount of material that may be taken up by the bead

4 External beads necessitate the use of longer locating pins on the form block and before the part is properly seated by the rubber it tends to shift at times, elongating the locating holes and distorting the part generally.

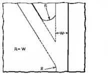


Fig 7—Blending external beads

Ten-fold Expansion

(*Continued from page 61*)

oratories (Fig. 6). All units are tested in accordance with test specifications prepared and issued by the engineering department. Test reports and log sheets are made up in duplicate for each unit, one copy of which is submitted to the engineering department and the second copy retained by the test department for future reference. After units have passed all specified tests, they are returned to the assembly department for disassembly and subjected to a complete and detailed inspection to determine if any defects have developed during the severe tests to which the unit has been subjected. After inspection, the units are again reassembled and transferred to the final inspection and finishing department for safety wiring of screws and attachment of small fittings such as lockwashers, nuts, and parts which would have interfered with the test procedure. All units are then inspected and delivered to the stock room ready for shipment.

The development of new and improved production test equipment plus the segregation of products into various classifications under the supervision of specialized personnel has been one of the major considerations in increasing production output. In addition, continued improvement and simplification of product design combined with the standardization of production units have also been important factors in reducing assembly time and the consequent production of completed units.

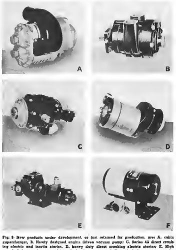


Fig. 8 New products under development, or just released for production, are: A. cabin supercharger, B. Newly designed engine driven vacuum pump; C. Series 43 direct cranking electric and inertia starter, D. heavy duty direct cranking electric starter; E. High speed, light weight motor driven hydraulic pump, and F, typical dc-ac convertor for autosyn power supply requirements.

Personnel Requirements

As manufacturers of starting and generating equipment, Eclipse Aviation has steadily expanded manufacturing facilities, through research and development, to embrace numerous additional products contributing to the safety and efficiency of modern aircraft. The increased demands of the National Defense Program have necessitated the employment throughout the aircraft industry of many new and inexperienced personnel. Although there has been a certain amount of difficulty in obtaining skilled labor, especially in the form of tool designers, hand screw and grinder operators, Eclipse Aviation has found from experience that the careful selection of unskilled personnel supplemented by a concentrated educational program, has resulted in obtaining sufficient personnel capable of serving as machine tool operators. In this connection, throughout the foundry, production, assembly and test departments, the responsibility for training has been delegated to the foreman or department head with the result that considerable success has been experienced in meeting personnel requirements after a relatively short period of training.

In order to utilize all available facilities of the plant at Bendix, New Jersey, all hourly rate employees have been placed on a two-shift, sixty hour week basis, the day shift operating on a six-day week of ten hours per day and the night shift operating on a five-day week of twelve hours per night. Under this system of operation the plant is operated at almost full capacity for the maximum hours available with time provided on Sundays to take care of emergency repairs and the maintenance of plant production equipment.

Consideration of personnel as well as machine tool requirements were important factors in the selection of sub-contracting plants to meet the expansion requirements of the National Defense Program. The use of sub-contracting plants in various localities previously operating at reduced capacity has resulted in the segregation of personnel requirements over a wide area thereby simplifying the problem of obtaining skilled labor. On the other hand, expansion of existing facilities with the resultant concentration of personnel requirements at one given locality would have necessitated the employment of a large number of migratory personnel in order to meet existing requirements.

(*Turn to page 174*)

Ten-fold Expansion

(Continued from page 172)

Development and Research

Although the major problem of the Aircraft Industry today has been the expansion of facilities to meet the requirements of the National Defense Program, Eclipse Aviation has found that continuation of development and research (Fig 7) on a larger scale than heretofore previously attempted has resulted not only in the simplification and standardization of current production design trends, but has also brought about the development of many new and improved types of aircraft accessory units

In a constant endeavor to meet the increasing requirements for new and improved aircraft accessory components (Fig 8), the present large staff of experienced research, development and test engineers has been supplemented to carry on important new projects In addition, scientific experimental laboratories have been further expanded and additional modern testing equipment made available in order that this program for development of new products may be carried on as rapidly as possible.

Among the foremost products undergoing development which will be subsequently, or have recently been, released for production are a complete new series of aircraft engine starters, generators, converters, air pumps and cabin supercharging equipment (Fig 9) In addition, many new products for specialized application are undergoing development for both commercial organizations and military services in order to meet the requirements of contemplated future aircraft construction,

Summary

In concluding, the fundamental requirements of the Eclipse Aviation program for expansion may be summarized as follows

1 Expansion of existing, and the leasing of additional, manufacturing facilities.

2 Selection of sub-contractors for the manufacture of complete units, tools, and parts to Eclipse specifications

3 Decentralization of manufacture through the use of sub-contractor plants and the leasing of additional plants

4 The addition of a complete and modern foundry to maintain a continuous and uninterrupted flow of quality castings to the production department

5 Modernization of plant equipment combined with improved planning, production and inspection methods

6 Segregation of personnel requirements through the use of sub-contracting plants, the training of unskilled labor and the employment of additional personnel operating on a 2-shift, 60 hour week.

This program for expansion was adopted due to the flexibility of control, the rapidity with which production can be increased to meet changing requirements, and the ease with which adjustments can be made after the abnormal requirements of the Defense Program have been completed.

Eclipse Aviation Plants

The above photograph shows the three plants which Eclipse Aviation is now using A large picture of these plants was published in Part I of this article which appeared in the September issue of AVIATION Through an unfortunate error, due partly to the fact that government restrictions now make it necessary to eliminate all backgrounds from aerial views, the plants were not labeled correctly The buildings at the top of the above photograph are of the large plant of Eclipse Aviation and Pioneer Instrument at Bendix, N J This plant was designed and built expressly for Eclipse and Pioneer on the large airport owned by Bendix Aviation Corporation

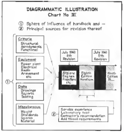
The plant in the center of the above photograph is the Eclipse unit at East Orange, N J This building alone gives Eclipse approximately 100,000 sq ft of floor space The large building at the bottom of the above photograph is in Philadelphia and was leased by Eclipse and Pioneer It furnishes an additional 640 000 sq ft of floor space.

Warplane Specifications

(*Continued from page 69*)

range to arrive at the airplane projected, the estimates on performance, weight, and cost are liable to be less accurate.

The Air Corps is constantly receiving and analyzing trouble reports from airplanes operating throughout the world, and from these reports is able to modify design requirements and operation instructions which form the basis for revisions of the Handbook installation, equipment, and material specification revisions. (Chart III) These data are also used in the formation of new type specifications for airplanes which will be issued prior to the release of the Handbook and other materials which are at that time in the process of being revised New design policies are formulated as the result of activities of several professional societies, particularly the Institute of Aeronautical Sciences and the Society of Automotive Engineers. Papers are read at meetings of these various technical societies throughout the country and annually these two major organizations sponsor national meetings attended by leading representatives of the industry The Army and the Navy send members to the society meetings and also to the airline maintenance meetings. The engineering department has members in most of the societies and organizations mentioned above and is constantly in touch with the Air Corps and the Navy Department In order that it may be abreast of the very latest requirements and proposed requirements Obviously the cost of designing and manufacturing is directly affected by new requirements which are being evolved Some of the changes result in a decrease in cost, decrease in weight, or an increase in service life, or all three



It may be in order to discuss briefly the procedures in effect during and after an award has been made Certain drawings are submitted to the Procurement Agency for review and release It is the intention of the Government to provide a coordinating officer on each project to insure that the proposed airplane fulfills the major requirements of the competition and provides the utmost in usefulness and service life. It is obviously impossible to set up requirements detailing the countless factors which influence design work. Instead of trying to do this, the government provides technical experts to act as consultants for the review and the release for fabrication of certain types of construction, new methods of control, improved power control and so on

The point of view which we adopt is that the government has for our use on these projects a group of consulting engineers who will offer suggestions, recommendations, and sometimes insist that certain modifications be made before the drawings are released for fabrication This procedure offers every advantage. The government's representatives, viewing the drawings or descriptions of a proposed installation can apply their service experience and "build out" of the proposed design certain imperfections which they have found in similar equipment built by another contractor or government agency which has been found unsatisfactory It frequently happens that many worthwhile changes are incorporated into a design while it is still only on paper by such a procedure

Before airplane construction is begun, a delegation from the Procurement Agency arrives at the contractor's plant and reviews the full scale mock-up The mock-up also acts as a clearing house for interferences among various items The mock up board listens to both sides and decides which item has preference in a particular location

To return again to the main subject of this article, let us now assume that we have entered Phase Three. Before we actually begin work it is necessary that each layout be approved by the Project Officer of the Air Corps Similarly all of the stress analysis and performance calculations are carefully reviewed and the necessary supplements issued

The specification is then rewritten, this time anticipating the production of an airplane from the requirements stated therein Corrections in weight, performance, descriptive matter, and so on, along with increases or decreases in previously stated bid prices are put into effect The Project Engineer may then take the layouts and typical assembly drawings and pass them to his group leaders who by this time have a number of men working for them Each drawing is covered by a memo outlining for the information of the Group Engineer what is desired from him in this particular case At this point, a design directive, which has been in the process of preparation, is made ready for release The design directive is the final authority from the Chief Engineer, the Chief Research Engineer, and the Chief Project Engineer to the Project Group and all members of the department for the conduct of work pertaining to that particular airplane The many factors which bear upon the project are accumulated by the airplane specification group who assemble this material into this design directive The design directive not only includes the requirements set forth in the type specification, but reviews the entire project so far as the execution thereof is concerned and provides each group engineer with all material available for the solution of the problem through the coordinated effort of the department and the customer Revisions of the design directive are made as frequently as occasion demands Copies of the directive are in the hands of the customer and affected members of the organization remote from the home office engineering department who are concerned with the actual solution of the problem

It is the responsibility of the Specification Staff Engineer to keep the estimating and production departments acquainted, by amendments to the design directive and other means, with all changes to the airplane affecting production or cost so that, if warranted, the Procurement Agency can be advised of this condition and a course of action can be recommended. A schedule of static tests is coordinated with the date schedule of the projects so that representative parts can be built up in the

Beck & Robb

(Continued from page 176)

experimental department for test in the structures laboratory to verify that satisfactory strength is developed in representative parts of the airplane. While the stress analysis can predict within very close limits in most cases what loads can be absorbed without damage to a particular part or arrangement of parts, it is required by the Procurement Agency that certain parts be tested to destruction so that guess work in highly stressed regions be absolutely eliminated.

It is important, too, that an understanding be reached between the contractor and the Procurement Agency, and between engineering and the shop as to specific standards to be maintained in tolerances and processes so that the parts subject to static test can be duplicated exactly in the airplanes to be built. Tests covering vibration, heat exchange, pressure regulation, air flow, and liquid flow characteristics, complete wind tunnel analysis, and many other tests and special investigations are continuously in process during the design stages. The results of these tests are coordinated with the various groups doing the design work and changes to the design are passed on to the group engineers through the medium of the design directive.

Mock up

The engineering department must also plan its work and freeze basic layouts sufficiently early so that tool design can proceed with manufacture of jigs and tools for the first airplane and for the airplanes which will be placed in the production line. Meanwhile, the equipment groups and power plant section have established necessary communications and verification with the suppliers of engines, propellers, generators, voltage control regulators, and so on. Full scale mock-up work is carried out with great precision and plans are put into effect as early as possible so that a typical power plant can be run long before the airplane is ready to receive such a power plant. The recent addition of turbo supercharger and other methods of increasing power at high altitudes further complicates the already involved problem of airplane design. Every attempt is being made to relieve the pilot of specific operations by introducing automatic devices to control the temperatures or pressures so that a minimum of effort is necessary on his part. Such devices must necessarily be so designed with either manual override or automatic cut-out that the failure of the device will not jeopardize the safety of the airplane.

In the meantime, our patent division and legal department are reviewing our design work, usually through the medium of the design directive, for indications of patentable features. The Lockheed Standards Group is attempting to develop new standards or improve old ones to increase the overall efficiency of the airplane and our manufacturing facilities. The shipping department and inspection department are made fully aware of the requirements of the airplane so that they may coordinate their work with the schedules and with the physical article itself. Suggestions are carefully considered and, if meritorious, incorporated in the design at the earliest possible moment.

Final Corrected Information

At the completion of a contract, a phase is entered into about which little is generally known. This phase is called "Final Corrected Information," and consists mainly of bringing the drawings and specification up-to-date and supplying vandyke and blue-print copies of these data to the Procurement Agency so that the airplanes described thereon can be intelligently serviced in the field. As soon as sufficient material is at hand, preferably including flying experience, operating instructions are written. The contract will also call for erection and maintenance instruction and special tools necessary for the maintenance of the airplanes in the field. All of these items must be carefully coordinated and available for the customer at the proper time.

Test flight

The experimental airplane is finally ready for flight and the pilot takes the airplane into the air with every confidence that all of the factors that contribute to the safe operation of that airplane have been considered and it is a safe flying machine at that time. His job is to verify that the countless assumptions, calculations, and estimates that have been made incident to the laying out of the structure, control surface, power plant installation, and instruments have been correct and to take necessary notes and measurements so that these data can be verified. The day of hair-raising, breath-taking first flight operations has long since lost its place in the manufacture of airplanes.

Engine Air Filters

(Continued from page 70)

nearly approaches the actual dust encountered in actual service The analysis of this dust is also given in the Supplementary Data.

Figure 2, clearly indicates two rather important results of this research. A comparison of the efficiency and resistance curves of filters "A" and "C" indicates the difference in performance which can be obtained in two filters having the same dimensions by using different types and arrangements of filter media These curves also show that the best ¾ in. thick filter is far inferior in performance to the best 2 in thick filter from the standpoint of cleaning efficiency, dust-holding capacity and resistance The most important thing to consider when comparing the performance of these three filters is "What happens to cleaning efficiency and resistance when a certain dust load has been accumulated?"

In providing air filter protection for an engine we are not very much interested in the initial resistance or initial cleaning efficiency What we want is a filter which will have a certain minimum average efficiency and a certain maximum resistance when subjected to a certain dust load. Referring to Fig 2, we could write specifications something like the following, which could not be met by a ¾ in thick filter having performance characteristics inferior to Filter "A" or a 2 in thick filter inferior to filter "G";

Typical Specifications for 2 in Thick Filter An air filter 2 in thick shall be provided having the following characteristics when the velocity of air flow through the net filter area is 600 f p m With a test dust consisting of 95 percent foundry sand and 5 percent sharp sand as per attached analysis, the filter must have an average cleaning efficiency of not less than 96 percent and a resistance of not more than 4 in water gage when subjected to a dust load of 1450 grams per sq ft of filter area (net area)

It is obvious from the above specifications that we have demanded about three times as much dust-holding capacity from the 2 in. thick filter In actual service this means that we can handle approximately three times the dust load with a 2 in thick filter with the same maximum resistance and somewhat higher average cleaning efficiency and consequently can establish a servicing schedule which will require less frequent cleaning

The following tabulation of data gives the necessary information for altering specifications within certain limits We have tabulated maximum and minimum as well as average efficiencies and have also indicated the dust-holding capacity of filters "A" and "C" in percentage of the dust-holding capacity of filter "G".

Filter Data

Filter	Thick ness	Dust	Res Inch	Dust Load GMS / Sq Ft.	Max Eff %	Min Eff %	Ave Eff %	Dust-Holding Capacity —%*
A	¾"			361 0	99 0	93 0	96 7	33 5
C	¾"	Sand	2"	225 2	98 5	91 7	95 6	20 8
G	2"			1077 5	98 5	97 0	98 4	100 0
A	¾"			450 0	99 0	89 0	95 3	36 0
C	¾"	Sand	3"	322 8	98 5	83 0	92 3	25 8
G	2"			1250 6	98 5	91 5	97 6	100 0
A	¾"			525 0	99 0	86 0	94 4	35 8
C	¾"	Sand	4"	412 5	98 5	72 0	88 3	28 2
G	2"			1461 8	98 5	86 0	96 5	100 0
A	¾"			365 5	93 0	80 0	92 0	35 8
C	¾"	Cement	2"	238 2	95 0	90 0	93 6	23 3
G	2"			1021 25	96 5	96 5	96 5	100 0
A	¾"			475 1	93 0	86 0	90 9	38 7
C	¾"	Cement	3"	323 5	95 0	83 5	91 1	26 3
G	2"			1227 5	96 5	96 0	96 5	100 0
A	¾"			553 5	93 0	82 5	89 3	40 4
C	¾"	Cement	4"	393 75	95 0	77 0	89 5	28 8
G	2"			1368 1	96 5	93 5	96 2	100 0

* Filter "G" which has highest dust-holding capacity is taken as 100 percent and other filters compared to it in percentage

Installation of Air Filters

The installation of air filters in airplanes is primarily a problem for the airplane designer Having determined the amount of filter area necessary to take care of the maximum actual displacement of the engine, without exceeding the minimum allowable velocity through the filter, the problem of installation boils down to finding a convenient place for mounting the filter If possible air filters should always be flat, and preferably square or rectangular in shape In cases where the filter area required is rather large two or more smaller filters can be used rather than one large unit There are a few other points which deserve special emphasis

(1) Filters should be mounted in such a way that they can be easily and quickly removed for servicing and replaced

(2) Suitable means for fastening filters tightly in place should be provided, and special attention should be given to the air seal, which prevents unfiltered air from by-passing the filter

(3) It is obviously necessary to provide a by-pass around the air filter which can be operated mechanically or automatically and used in case the filter becomes clogged with dust, snow or ice

(4) If practical air filters should be mounted at an angle of less than 90 deg to the direction of air flow, as indicated in Fig 3, in such a way that the air passes upward through the filter They may also be provided with louvres, so that the heavier dust particles will be deflected downward and out through suitable ejector slots The wrong way of mounting filters is at an angle to the direction of air flow It is obvious that with a filter installed in this manner all the dust entering the air scoop must either be caught in the filter or pass through to the engine, and the vibration of the plane would tend to shake the dust through the filter instead of shaking it off as would be true with the installation shown in Fig 3

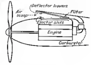


Fig 3. The correct method of installing a filter in an air scoop

Douglas Plant

(*Continued from page 53*)

now under erection in Tulsa, Okla. In setting up the Long Beach plant under Howard Houghton, Douglas drew liberally on personnel from the Santa Monica factory, providing an experienced and capable skeleton organization as a nucleus around which to build. A majority of the workmen are being drawn from the neighboring town of Long Beach.

Although there is a tremendous quantity of primary fabrication work already under way in the Long Beach plant, much of the major sub-assemblies and component parts to feed the final assembly lines will be fed in from eastern and mid-western sub-contractors. Special railroad cars will shuttle back and forth carrying completed parts. Provision has been made for running these cars right into the plant at any desired point. There is also adequate provision for operation of trucks directly into the various buildings for delivery of parts and supplies wherever needed.

While all basic airplane design work will continue to be handled at the parent plant in Santa Monica, an extensive tool design and production engineering department has been provided at Long Beach.

Factory construction

Originally estimated to cost $12,000,000 and provide 1,400,000 square feet of working floor space, it is now rumored that the Long Beach factory will be doubled in size immediately in order to do justice to the "Flying Fortress" production schedule. Located on a 200-acre site, the Long Beach plant has ample room for expansion. The factory buildings are in the northeast corner of the Long Beach airport area, with full access to the runway system. Main highways parallel the plant on the east and north, providing easy transportation for workers. A huge parking lot to the east of the plant is reached by means of a pedestrian subway extending under the highway.

Early occupancy

Although several buildings were then uncompleted the factory was placed in production early in September. Formal dedication was scheduled for September 26, with 4,000 people already at work and hiring progressing rapidly in a drive to employ 15,000 people before the end of the year.

Designed by Edward Gray Taylor and Ellis Wing Taylor, the new Douglas plant was built by the P. J. Walker Co., of Los Angeles. Ground was first broken on November 22, 1940. Despite serious delays in preliminary excavation work due to "unusual" winter weather, the plant has been completed in less than ten months. In erecting four of the assembly units, 3763 tons of structural steel were raised and riveted into place in 32 working days, an average of nearly 120 tons daily. A total of more than 9000 tons of structural steel and reinforcing bars went into the plant construction program. Approximately 9000 mercury vapor lamps and 5000 fluorescent lamps were installed for lighting. Nearly 2,000,000 lbs of sheet metal went into the ventilating duct system. Approximately 5700 horsepower of electrical installations were required for the air conditioning equipment.

Building layout

The factory is arranged with the main office building, a three-story concrete windowless structure, facing east at the intersection of Lakewood and Carson Boulevards. A one-story employment and personnel building and a one-story employee welfare and restaurant unit also face Lakewood Blvd., and are of similar construction. Behind these units are two fabricating buildings, two final assembly units, a raw stock storage structure, shipping and receiving buildings, paint storage, and a large garage. These buildings are all of one-story design with high ceilings and structural steel framework throughout. Provision has been made for addition of mezzanines in all units, enabling further expansion of work area within the present buildings. All areas between buildings are paved, providing ample yard space for outdoor final assembly work, a feature of all California's aircraft plants.

Each building is completely air conditioned and has several units on each roof

Modern equipment

Throughout the plant the most complete and modern equipment is provided. Straight line materials flow and assembly path has been provided for throughout the plant, so that there is no back tracking or cross moving of materials and assemblies. Overhead cranes provide rapid handling of all parts and materials. Along the assembly lines, both in fabrication and final assembly, wing and fuselage jigs are set on tracks and are moved by mechanical power at regular intervals.

Row on row of the latest machine tool equipment has been installed in the machine shop, including one line of 45 lathes, and a group of 70 milling machines of various types. Other equipment for electric and gas welding, tank testing, heat treating, sand blasting, plating, grinding, magnafluxing, etc. has all been installed and is already in operation.

Much of the equipment has been built to special requirements such as the two new six-sided hydraulic presses, each of 2500 ton capacity. On each of their six sides is an electrically operated loading table. By this method it is believed press production will be speeded at least 50 per cent beyond any previous accomplishment.

Personnel

Not all the thought and effort in the new plant has gone into bomb proofing and special equipment. A great deal of attention has been devoted to the latest scientific methods of hiring and training new workers, and to providing for the comfort and safety of those employed. Complete hospital equipment is provided and thirty trained nurses are already on duty. Special areas have been allotted for recreation during lunch hours. To augment the company cafeteria a number of travelling cafeterias will tour the grounds at meal times bringing hot food to all parts of the plant.

Production, started early in September, will soon reach full flood. While there is reason to doubt that Hitler will ever personally inspect this plant it is quite likely that he will have plenty of opportunity for viewing the results achieved with planes produced there.

Flying the Atlantic

(Continued from page 63)

upon the use of long-range direction finding radio stations located at key points on the airway and operated either by Pan American or cooperating European governments upon the availability of alternate points of landing on the coast of Europe, in England, Ireland, Canada and Newfoundland The outbreak of war and President Roosevelt's Neutrality Proclamation prevented the realization of such air transport advantages

Finally, the outbreak of war and particularly the identification of U S interests with those of Great Britain in that war completely changed the character of the transatlantic airway in its relation to the national welfare In transport terms it changed the objective of this enterprise from that of rendering a gradually-improving commercially-adequate service, to that of carrying, in the public interest, the largest quantities of mail cargo and the greatest number of passengers physically possible with the equipment available. Air mail loads presented for passage (and Pan American has never failed to accommodate all mails so presented) quickly grew to ten times the average size ever estimated as to-be-expected either by the airline or U S governmental authorities. Individual mail loads actually upon occasion reached as high as 13,000 pounds. Despite the fact that passenger loads of thirty three passengers have been carried on eastbound trips and thirty-five have been carried on westbound flights (both in addition to mail), demands for passenger accommodations for a long time remained so great that the compilation of each passenger list became a matter not so much of traffic bookings as of selecting those passengers whose crossing would be of the greatest national interest.

To offset this formidable array of difficulties, the chief asset available to the Pan American Airways System was an experience of almost ten years in transoceanic flying across the Caribbean and the Pacific Out of this experience it evolved an extensive and highly developed doctrine of practices designed to bring to each of the many phases of transatlantic operations the concentrated lessons in operations in other ocean areas The effectiveness of this Pan American technique in two and one half years of transatlantic operations can be set forth entirely within the statement that during that period Pan American's Clippers had, by September 5, 1941, completed 433 scheduled flights without a "serious incident" of any kind and in absolute safety to passengers, personnel, and cargo

The technique itself can be set forth in several different ways For our purposes here, we shall treat it as divided into (1) the use of a highly trained Multiple Flight Crew, (2) a highly developed system for the Scientific Control of Flight, and (3) the development of what is called the Quick Turn Around system of maintenance to achieve a maximum utility for a limited number of aircraft The second and third of these items are to be treated in detail in subsequent issues of AVIATION

A Radio Officer taking bearings by turning a direction-finding loop.

The Multiple Flight Crew was first conceived for the four-engined Sikorsky Flying Boats developed for the transcaribbean service Operations over comparatively large distances in the tropics from early in Pan American history determined the use of code rather than voice radio To handle the comparatively heavy work of such code equipment, the smallest Pan American crew is fixed at three members a pilot, co-pilot, and a radio operator With the coming of four-engined equipment, a flight engineer was added to this crew to watch over the precision controls and complex adjustments of the power plants

As Pan American's flying stepped up to the scale of Pacific distances, the Company's operating technicians analyzed the sum total transoceanic flight assignments into six prime requisites (1) expert direction of the flight (2) piloting (3) navigation (4) control and care of the power plants (5) maintenance of communications (6) passenger service. Not only must each of these tasks be performed perfectly but the crew must be so constituted that adequate relief watches (approximately 50 percent of total flight time) can be enjoyed on long flights by each crew member. Added to this was the obvious desirability that there should be enough versatility in the training of these men so that the emergency incapacity of any one or several of them could not threaten the safety of the flight Upon delivery of the Boeing-built Clippers and the inauguration of transatlantic service, the standard crew which mans a Clipper in Atlantic (or Pacific) service consists of eleven men, each as fitted for his constituted duties as his painstaking selection and organized training can make him.

It is perhaps more proper to refer to the men who handle the transoceanic Clipper as a Captain and his crew of ten The Captain of a Clipper is responsible at all times during a trip for the safety and well being of the persons and goods carried, for the safety and conduct of his crew, for the safety of his aircraft, and for the completion of his mission in accordance with his orders The Captain's normal station is the left-hand pilot seat, which he occupies during all take-offs, approaches to airports, landings, during emergency conditions, and at times when he is serving his watch at the controls While in flight, the Captain supervises the remaining crew members to determine that they are properly carrying out their duties and responsibilities The Captain prescribes the speed, track, and altitude of the aircraft.

The First Officer is second in command after the Captain and alternates with the Captain as the senior officer on watch. The First Officer's station is the right hand pilot seat In the absence or incapacity of the Captain, he automatically assumes complete command The Captain delegates to him detailed responsibility for the management of the crew and for the handling and documentation of the aircraft at all ports He is responsible for the proper loading and unloading of all cargo. Prior to departure, he makes a general inspection of the aircraft which includes a check of its air controls, a check of the ship's documents, an inspection for stowaways, and a final verbal or written report from each responsible Flight Officer

The Second Officer is responsible for the safe and efficient navigation of the aircraft He is responsible for the complete complement of navigation instruments and equipment aboard the aircraft This involves ascertaining that complete equipment is on board prior to each flight, as well as care of the equipment during the trip He records in the Aircraft Log the record of navi-

gation procedures and operations statistics.

The Third Officer, who is a pilot in training, assists and/or relieves the other officers in the performance of their duties. Prior to departure, the Third Officer assists the First Officer in the preparation of the Weight and Balance Manifest. He personally supervises the actual loading of the aircraft in preparation for the First Officer's final inspection. Also prior to take-off, he ascertains that all hatches and bulkhead doors are closed and so reports to the Captain. Immediately after take-off, he conducts a visual examination of major external structural components and reports his findings to the Captain. Prior to landing, when required, he receives a report from the Steward that fly spray has been used in the cabin and prohibited vegetable matter jettisoned. He handles the bow mooring line when casting off and mooring. During flight he serves primarily as relief for the Navigation Officer.

The Flight Engineer is responsible for the mechanical condition and mechanical operation of the aircraft. He is responsible for the loading of fuel and oil in amounts specified by the Captain. He personally measures the fuel and oil aboard before each departure. Prior to departure, he personally participates in the inspection and/or serving the aircraft to which he has been assigned. He familiarizes himself with the mechanical history of the aircraft since his last contact with it. During flight, he maintains the sections of the Log pertaining to the mechanical condition of the aircraft.

The Radio Officer is responsible for the efficient utilization of the radio equipment aboard the aircraft. He maintains the sections of the Log pertaining to the radio equipment.

The Flight Steward is responsible for the efficient handling of passengers, passengers' baggage, mail and express enroute. He is responsible for all ship's papers pertaining to mail, express, baggage, and the clearance both of the aircraft and the persons aboard. He is responsible for the proper care of passengers' baggage from the time he receives it at point of origin until he delivers it at point of destination. He arranges for the receipt and proper discharge of all express, and likewise for the receipt and discharge of all mail. He is responsible for the procurement, storage and service of all foodstuff used aboard the airplane. He is personally responsible for the cleanliness and attractive appearance of all passenger quarters aboard the aircraft including the galley and toilets, and for the equipment and supplies necessary for passenger service. He contributes to the comfort and pleasure of the passengers including the direction of organized recreation. He advises passengers with respect to hotel accommodations, taxi service, time of next departure, and other details essential to their convenience.

It will be seen that each of these officers is necessarily a specialist in discharging one of the primary requisites mentioned above—piloting, navigation, engineering, communications and passenger service. To each of these officers is assigned a capable assistant who relieves him at stated intervals. Thus, the typical Clipper crew is rounded out by a Third Officer who is a junior pilot in training and who serves primarily as relief for the Second Officer at the navigating table. The Fourth Officer is also a junior who assists the pilot officers in both flight and ground duties. An assistant flight [illegible] ant radio officer, and then an assistant flight steward, whose duties are obvious from their titles, fills out the complement.

To train these men, each for his particular duty, Pan American long ago developed a program of step-by-step assignments to duties of increasing complexity and has required the organized pursuit of correspondence courses and classroom work in many subjects. The Captain, for example, is invariably a veteran of many years' experience on Pan American's overland as well as overseas routes. In addition, he has qualified himself through research and study for the Pan American rank of Master of Ocean Flying Boats. This means that he has not only successfully demonstrated sound judgment throughout his flying career and is an expert in all phases of piloting but that he has also mastered the principal elements of aeronautical engineering, engine and airplane mechanics, navigation, meteorology, and radio. He must hold the equivalent of a Master Mariner's ticket. He has further qualified himself in those phases of international law, marine law, and business administration required in the performance of his duties.

In each Clipper crew, the Captain, the First, Second, Third, and Fourth Officers must all be qualified pilots, trained navigators, and expert enough in radio and engines to take over those assignments, if necessary.

Each of Pan American's transoceanic divisions operates well-equipped training centers in navigation, meteorology, and instrument flying where new airmen are indoctrinated and all flight officers are required to report for periodical reviews of new material and check-outs of ability.

Several of these schools are playing a direct part in the defense program. At the Miami base alone, a school operated by Pan American for the U. S. Army Air Corps and Royal Air Force, has been engaged for more than a year in teaching transoceanic and long range navigation and meteorology to cadets in those services. Present enrollment in the twelve-weeks course is approximately 300, equally divided between British and American cadets, and the over-all program calls for the training of at least 500 British and 2,000 Americans by the summer of 1942. Pan American training facilities have been used to indoctrinate military and naval mechanics and technicians in the maintenance of large aircraft and in the duties of flight engineers. In several instances, British crews assigned to take over American equipment have been put through special courses of instruction in these Pan American training centers.

From the outset, the Atlantic Division was very materially strengthened through its ability to recruit its crews in a large measure from Pan American's Pacific and Eastern (Caribbean) Divisions.

Atlantic is different

A point which must be made, however, is the fundamental difference required by the character of Atlantic operations in the service-training of Atlantic crews. Crews in the Pacific, for example, settle down to the process of learning the detailed crossing techniques and the landing problems of a single airway laid out across a finite number of bases each completely equipped with every piece of radio or other equipment which Pan American can devise to help in their operations. Atlantic weather and climate, changing requirements of war time regulations, Pan American efforts to discharge its task of carrying the maximum cargo and passengers between the two continents, has caused a shifting of routes far beyond anything called for by any previous type of air transport flying. For example, a Captain who has been in Atlantic service since the start of that airline, has possibly been called upon to make crossings: New York-Horta-Lisbon-Marseilles, New York-Newfoundland-Ireland-Southhampton, New York-Bermuda-Horta-Lisbon, New York-Bermuda-Lisbon, Lisbon-Bolama-Belem-Trinidad-Puerto Rico-New York. On westward journeys he perhaps has had to seek an ice-free U. S. terminus as far south as Miami.

It is reported from the LaGuardia field base that transatlantic flight personnel sometimes refer to the shifting nature of their route assignments as "transatlantic barnstorming." It was pointed out recently by a Pan American official, however, that the experience has resulted in a flexibility of technique and a versatility of training which may well prove of very distinct advantage as future events perhaps result in further modifications of the transatlantic service.

Selig Altschul

(Continued from page 88)

even included in business Indexes. Today, aircraft expenditures head the list in our defense program from the standpoint of new plant expansions and are second only to shipbuilding in point of order backlogs

Despite the tremendous activity in the aircraft industry, equities of leading companies are, with few exceptions, at the same levels they were two years ago To facilitate comparison, our table of stock averages shows the position of the various groups at representative dates since Sept 1, 1939 At the outbreak of war, the aircraft issues leaped about 12 percent Outside of this ephemeral move, the aircraft average has ranged in a relatively narrow channel and is now only slightly higher than it was early in Sept. 1939 The general market averages, however, are lower now than they were two years ago

The air transport group, never a war baby, during the first phase of the period, showed the most outstanding appreciation in the entire industrial list As restrictions became evident, however, the air lines quickly lost their market gains and hit their low-point as recent as July 18, 1941 with the average at 19 28 However, as the outlook became less beclouded, the air transport issues have been participating in a quiet rally all of their own with the result that on Sept 5, 1941 their average at 21 38 was about 50 percent higher than Sept 1, 1939

From here on in it is likely that both aviation averages will reflect their outlook as affected by the duration of the war and the appraisals accorded postbellum shocks and adjustments

The post-war aviation period has come in for a good deal of attention recently The Sperry Corp announced that it is preparing now to cushion the effects of any post emergency readjustment by appropriating from earnings substantial reserves earmarked for such purpose as well as amortizing defense production facilities over three years instead of the five-year period permitted by the tax law

From the Studebaker Corp comes word that the company has no plans to continue aircraft engine production in the post-war period. The company currently holds a contract to build Wright engines

No voluntary withdrawal from aircraft manufacturing may be anticipated from the leading automotive combines. General Motors, has long had an important stake in aviation and may be expected to emerge after the war more strongly entrenched Its Allison engine division, now a full-grown giant, may be expected to become a patent competitive factor General Motors also has major investments in Bendix and North American Aviation

Chrysler has indicated that it has under development an aircraft engine of its own design Ford expects to mass produce flivver planes.

All this activity by the automotive industry may indeed give aircraft builders sufficient cause to reflect upon new competitive forces along with finding peace-time markets for their greatly expanded facilities

Probably the most spectacular aircraft performer in the market, thus far this year, has been Cessna Aircraft Co Listed on the New York Curb Exchange early this year, the stock sold as low as $3 75 per share in April In less than five months the stock reached $14 87 per share—an appreciation of almost 300 percent This rise reveals one of the most interesting sequence of events in the aviation history today Up to Dec 31, 1940 the company was still operating in the red It was not until the first three months of 1941 that the company attained profitable operations Sharply increasing deliveries immediately found reflection in mounting earnings. Indicated earnings, after all charges and taxes, were $1 85 per share for the three months ended June 30, 1941 Estimates place final earnings of about $4 00 per share on each of the company's 350,000 shares outstanding for its fiscal year to end Sept 30, 1941 In July, the company paid 70 cents per share and recently declared another disbursement of $1 25

Going back to Sept 1937 we find that an underwriter had difficulty in marketing the company's stock at $1 65 per share (less than the dividends paid this year) In fact, in April 1938 this stock was being "peddled" at $1 40

The company has had its corporate difficulties and in its early days was rarely far ahead of the sheriff The aircraft boom, however, found a ready place for the company's product and its success is now established Smaller of the aircraft builders, Cessna has been concentrating upon a twin-engined trainer now in demand for training of bomber pilots The bulk of the business has been Canadian orders (higher profit margins), but the Army Air Corps recently gave the company an award in excess of $12 million.

Despite the booming aircraft activity not all companies in the industry have been uniformly successful For example, as a contrast to Cessna there is the case of Howard Aircraft Co A public offering of this company's common stock was made in May, 1939, at $3 00 per share Today, the best bid is seventy-five cents It is not our purpose here to analyze why this company fared so poorly It is important to note that no two units, even in the same industry, can be expected to follow similar patterns For this reason, it always is a baffling game—and a profitable one —to be able to detect where the lightning will strike next among a group of companies in any industry with a favorable outlook

Barron's Stock Averages

Sept 8, 1941

	Aircraft	Air Transport	40 Stocks
Sept. 5, 1941	39 45	21 38	73
Aug 29, 1941	38.33	20.53	74
Aug 22 1941	36.95	19 91	73
Aug 15 1941	36.03	20 25	72
Aug 8 1941	37.35	19 78	73
Sept. 6 1940	39.25	26 97	79
Sept 8, 1939	40.25	16 41	86
Sept 1, 1939	36.10	14 38	78

Casting

(Continued from page 162)

thing not a portion of the casting The castings are then heat treated if made of a heat treatable metal. Test bars are cast with each heat of metal and are heat treated with the castings of the same heat After heat treatment all castings receive a final inspection visually, for dimensional tolerances and warpage so that they will meet specifications and conform to the blueprint After this final inspection the castings are then ready for shipment

In order to closely control production, a research department is maintained by the foundry All plaster mix specimens are subjected to permeability and strength tests, since the molds must be sufficiently porous to permit gases to escape, firm enough to maintain a smooth surface, and have a high dry strength X-ray examination of castings is also employed to guide the metallurgist in establishing proper foundry techniques For instance, the temperatures at which castings are poured is highly important, since they vary with the size, shape and weight of the castings. The X-ray shows at what point the best results are obtained

In the final inspection department parts are checked for dimensional accuracy against engineering specifications before they are shipped Any found not to meet the plus or minus dimensions called for are rejected.

We were a **BIG HELP** to Jones on his order for

BOMB HOISTS

Manufacturer Jones ordinarily makes nonmilitary products. But a few months ago he got a contract to build bomb hoists. These hoists called for motors in fractional hp frame sizes rated 1½ hp (intermittent service), with rigid maximum weight specifications

★ ★ ★

Where to get motors meeting these requirements? Fortunately Jones had heard of some of the accomplishments of General Electric fractional hp motor engineers So he called us Our engineers studied the requirements and then furnished a motor that was exactly suited to the job—a motor that met all the desired performance specifications and yet was well under the weight limit.*

★ ★ ★

A few of many G-E motors specially designed for defense jobs

Aircraft bomb-hoist motor

Aircraft turret motor

Aircraft amplidyne set

Dynamotor for aircraft radio

With a staff of well trained engineers, excellent facilities, and great plant capacity, General Electric can be of real help in supplying you fractional-hp motors and similar equipment for your defense products Whenever you need motors, a few or thousands, we can serve you well. Call the nearest G E office, or write direct to General Electric, Schenectady, N. Y.

**This is a true story of General Electric service, although Jones is not the real name of the manufacturer*

GENERAL ELECTRIC

FIRE POWER INSURANCE.....

for the

MARTIN B-26 BOMBER

is provided by the standard Style DAP direct current Mu-Switch.

Just as the famous B-26 Bomber has fire-power . . . and plenty of it . . . so the Style DAP Mu-Switch has "fire-power" in its blow-out magnet which blasts the destructive D.C. arc away from the switch contacts and insures long, dependable service. Specially built for direct current operation, this switch warrants your consideration for the extra hard jobs in control of aircraft electrical circuits . . . especially those involving inductive loads. "It's the blow that makes the difference"

AS USED in the B-26

★ **BREAKS 20 AMP. D.C.** in the highly inductive circuit of a D.C. motor
★ **MAKES 30 AMP. D.C.** at 29 volts starting current of loaded motor
★ **200 CONTACTS PER MIN.** under this severe load cycle
★ **NO CONDENSER USED** to protect switch contacts against wear

PLUS THESE FEATURES

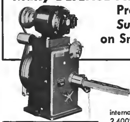
★ **LIGHT WEIGHT** only 1½ ounces complete
★ **ALUMINUM CASE** with standard ¾-20 hub
★ **COMPACT SHAPE** 1½ wide—3½ long—2⅜ high over-all
★ **ONE-PIECE SPRING** made of heat treated beryllium-copper
★ **PRECISION ACTION** only .001" differential, 5/16" over-travel
★ **HEAVY DUTY CONTACTS** single pole single throw normally closed

★ Write today for further details.
★ SAMPLE ORDERS FILLED PROMPTLY

Chosen by Martin engineers to control the ammunition boosters of this mighty fighting craft, this sturdy switch will satisfy your most exacting demand for precision control of direct current, inductive loads.

MU-SWITCH CORP., CANTON, MASSACHUSETTS

Are You Equipped to Handle the Many DEFENSE PROJECTS Requiring Precision Limits and *Super-Smooth Finish* on Small Diameter Jobs?



Hundreds of manufacturers — particularly those engaged in the defense program — have been quick to adopt this new, practical, inexpensive method to accurately size and finish internal cylindrical surfaces from .185" to 2.400" in diameter.

The Sunnen Precision Honing Machine does not *require a skilled machinist* — any intelligent workman with a few hours' practice can produce a *super-smooth surface finish* and hold accuracy to *one ten-thousandth!*

Can be set up and work located in less than a minute! Corrects taper and out of round holes.

We'll be glad to have a Sales Engineer call and demonstrate this machine in your plant — on your job — or

Send for NEW BULLETIN giving complete details and examples of the wide range of uses for this new machine.

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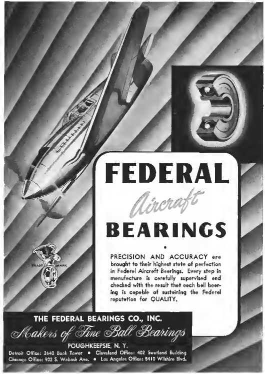

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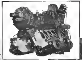

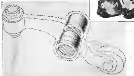

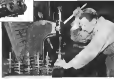

"TORRINGTON NEEDLE BEARINGS REDUCE FRICTION to so low a coefficient that their use means virtual elimination of wear" in Valve Rocker Arms of Ranger SGV 770 12-cyl. and 6-440C 6-cyl. engines, states Mr. P. E. Battilana, Service Manager of Ranger Aircraft Engines Division, Fairchild Engine & Airplane Corp.

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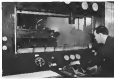

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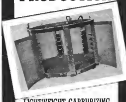

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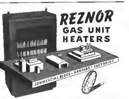

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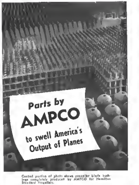

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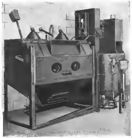

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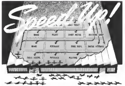

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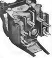

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